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Description and Tutorial
for

SIMOCRANE
Drive-Based Technology V1.0 SP1 HF1
with Sinamics CU 310-2

Siemens Cranes
Product Management
February 2013, Erlangen, Germany

SIMOCRANE Drive-Based Technology V1.0 SP1 HF1

Siemens Solution
for
Mid-Performance Crane Application

- A drive-based solution in SINAMICS environment
- Special Sinamics Firmware for Cranes application
- Crane specialized technologies in DCC-blocks
- Preconfigured standard applications (Ready-to-Run)
- Open for customized adaption (Ready-to-Apply)

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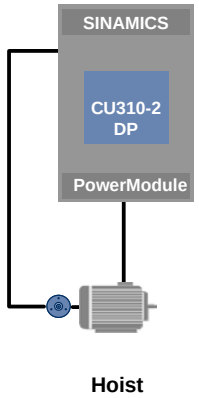
MC Cranes
Our product portfolio

			High Performance	Mid Performance
SIMOCRANE	Crane Technology	Crane Management System	 (Remote) CMS	 CMS Lite
		Advanced Technology	 Sway Control	
			 Skew Control	
			 2D-Trajectory	
			 Truck Position System	
			 ECO Technology	
		Basic Technology	 Basic Technology V3.0	 Drive-Based Technology
Platform	Motion Controller		 SIMOTION D435-2	
	Drive Controller		 CU320-2	 CU310-2
	Drives		 Crane Cabinet Modules  Chassis  Book-size	 PM340  PM250
	Motors		 1LA8/ 1LL8  1PH8  1LG4/6  1LP4/6	

Product Introduction

Functional Scope (1)

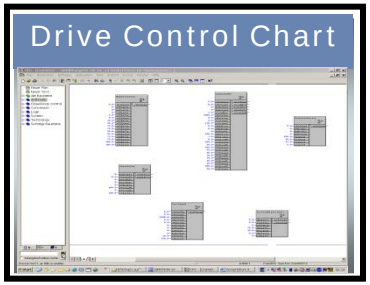
- **Crane midrange solution is**
  - A Sinamics AC/AC Single axis drive (power module),
  - Contol Unit CU310-2,
  - A special Sinamics FW V4.5 for Cranes and
  - Simocrane Drive-Based Technology V1.0 SP1 HF1.



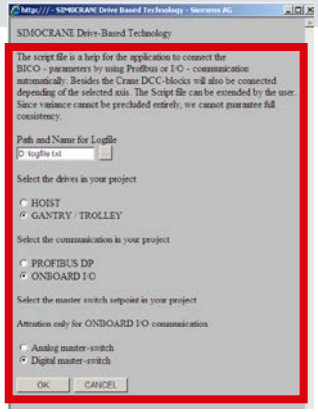
Hoist

- **This special Firmware can operate**
  - With PM340
  - With PM Chassis
  - With PM250
  - With Safety functions
  - without Servo-Control.

- **Crane technology in DCC-Blocks**
  - Load-dependent field weakening
  - Pre-limit switch (selectable limiting)
  - Start pulse
  - Master switch
  - Over-speed monitoring (not a fail-safe function)
  - Current distribution monitoring (for double Axes)

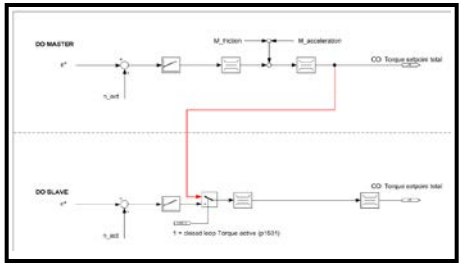


Functional Scope (2)



- **Standard applications via I/O-onboard or via Profibus**
  - Selectable via I/O-onboard or via Profibus
  - Selectable with analogue or digital master-switch
  - Combination of Startpulse with brake control
  - SingleAxis application for Hoist or Trolley or Gantry
  - DoubleAxes application for Master-Slave torque control
  - Configuration via scripting

- **Sinamics functionality**
  - Time-optimized positioning for a single axis
  - Master-slave closed-loop torque control
  - Brake control
  - Integrated Safety



- **The Crane DCC-chart is know-how protected, therefore, it can not be opened. The customized DCC application can be made in another DCC-chart under other Drive-Object (e.g. CU).**

- **There is no online-help in Sinamics Starter for user defined parameters.**

- **The grab function and synchronous operation are not parts of this product.**

Scope of Supply

V1.0 SP1 HF1

Memory card (CF card)

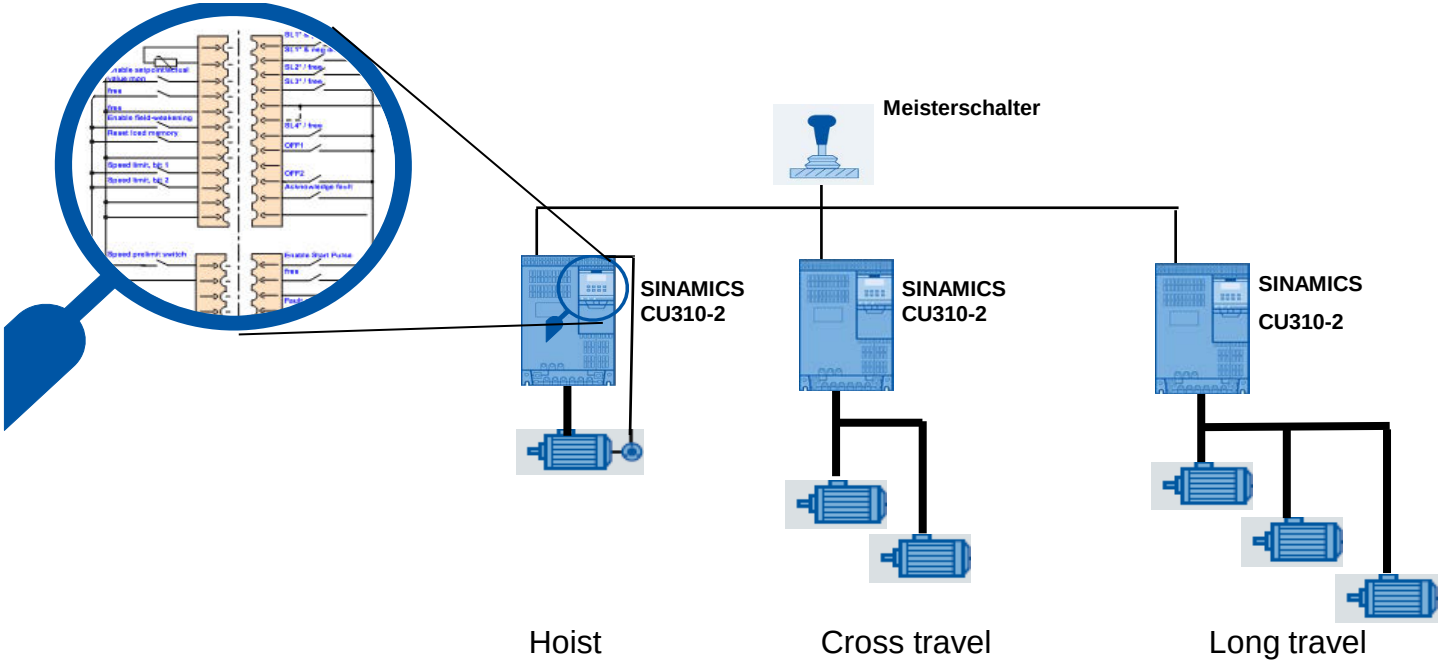
- SINAMICS FW V4.5.1 for Cranes

MLFB: 6GA7270-1AA11-0AA0

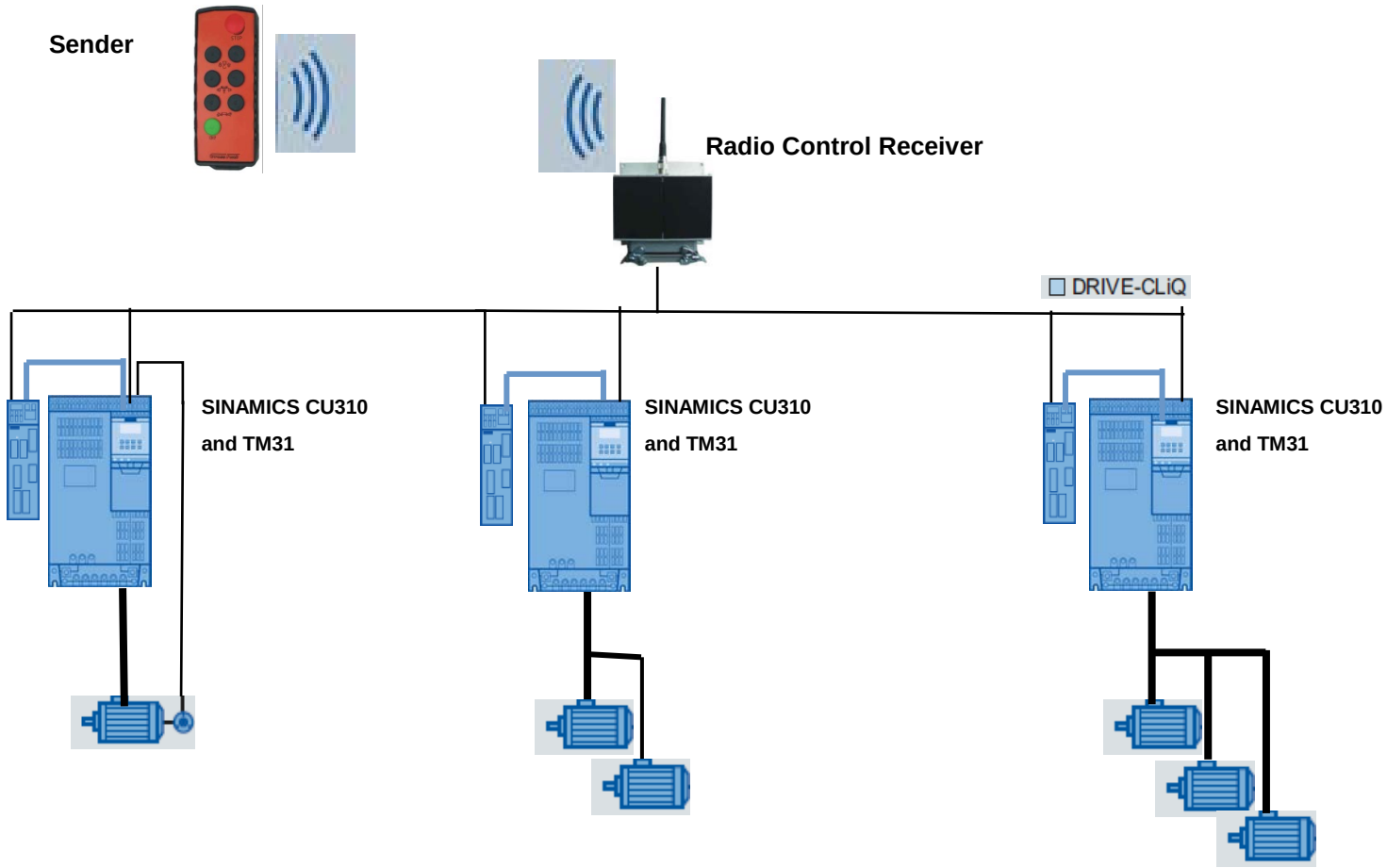
CD with:

- Cranes DCC blocks
- Standard applications
- Documentation

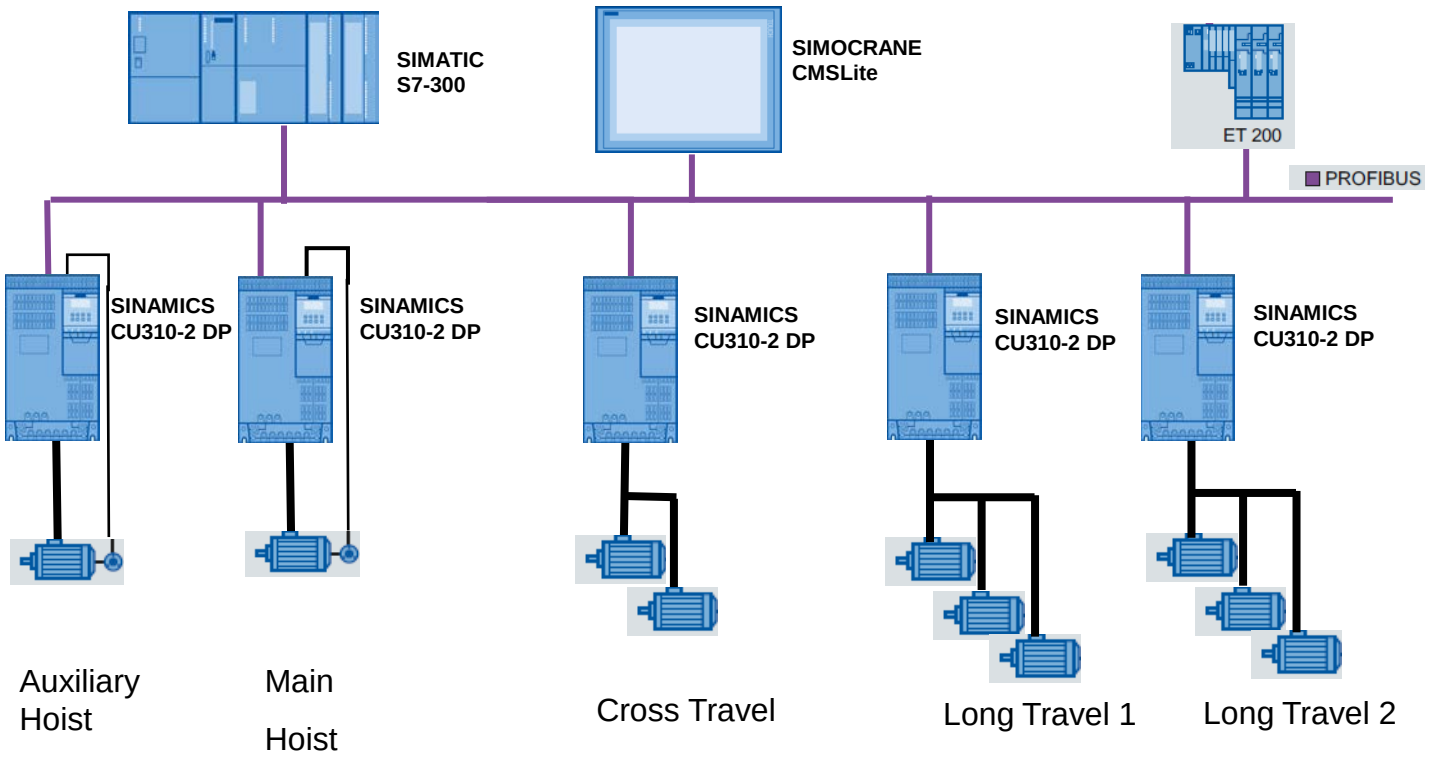
Configuration Example of OHBC with Onboard I/O-signal



Configuration Example of OHBC with I/O Terminal Board Control



Configuration Example of OHBC with Simatic Control via Profibus



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Commissioning Guideline

Commissioning Guideline


Sinamics
Getting Started


Adobe Acrobat
Document

1. Import project of SIMOCRANE Drive-Based Technology — Simocrane
2. Configuration of Drive object — Sinamics
3. Running Script — Simocrane
4. Motor identification (Sinamics Getting Started) — Sinamics
5. Parameterization of Crane DCC-blocks — Simocrane

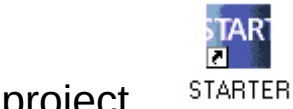
Refer to the manual “Sinamics Getting Started” and “SIMOCRANE Drive-Based Technology”, Chapter 6

Simocrane

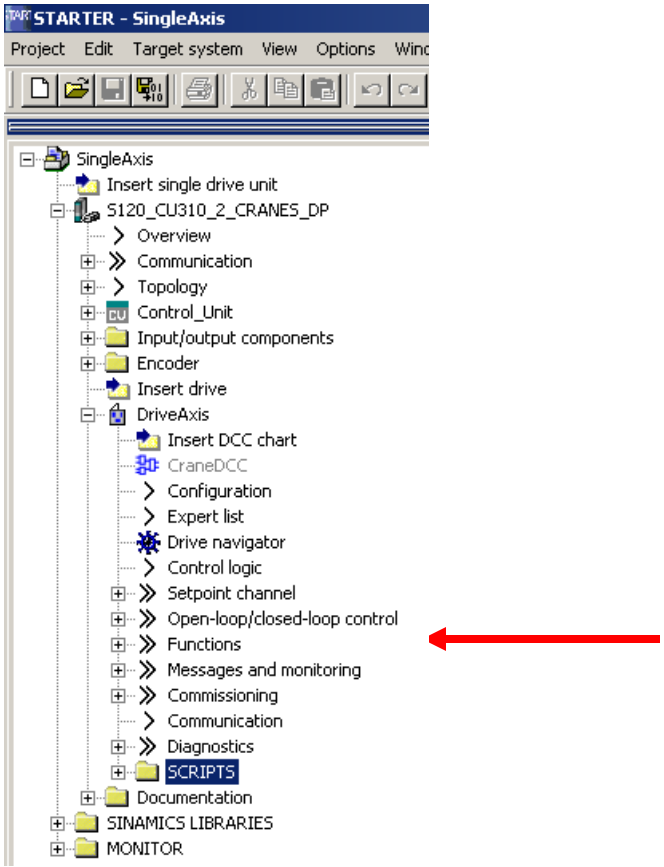
Import project with the IMPORT function

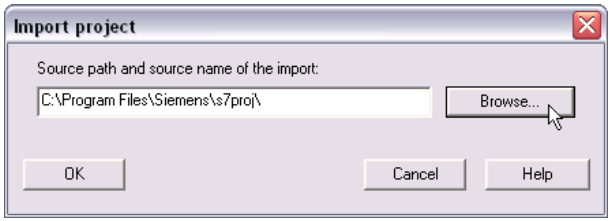
1. Start the engineering tool STARTER

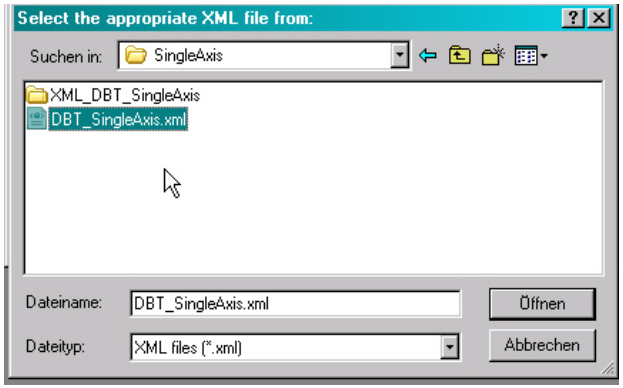
2. Actual project must be closed, then import the project



Step 1
Import project



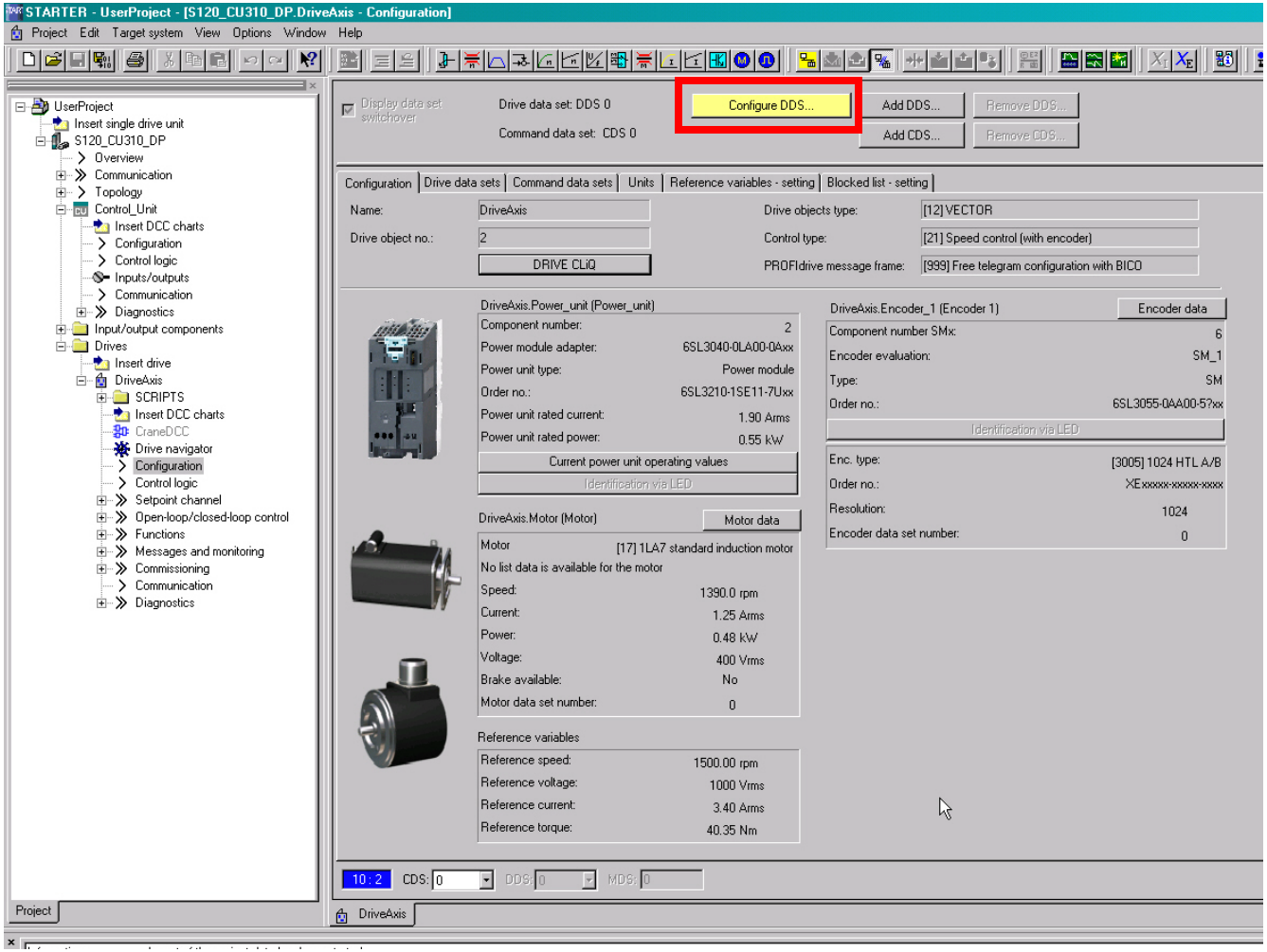




Configuration of the Drive Object (DO)

Sinamics

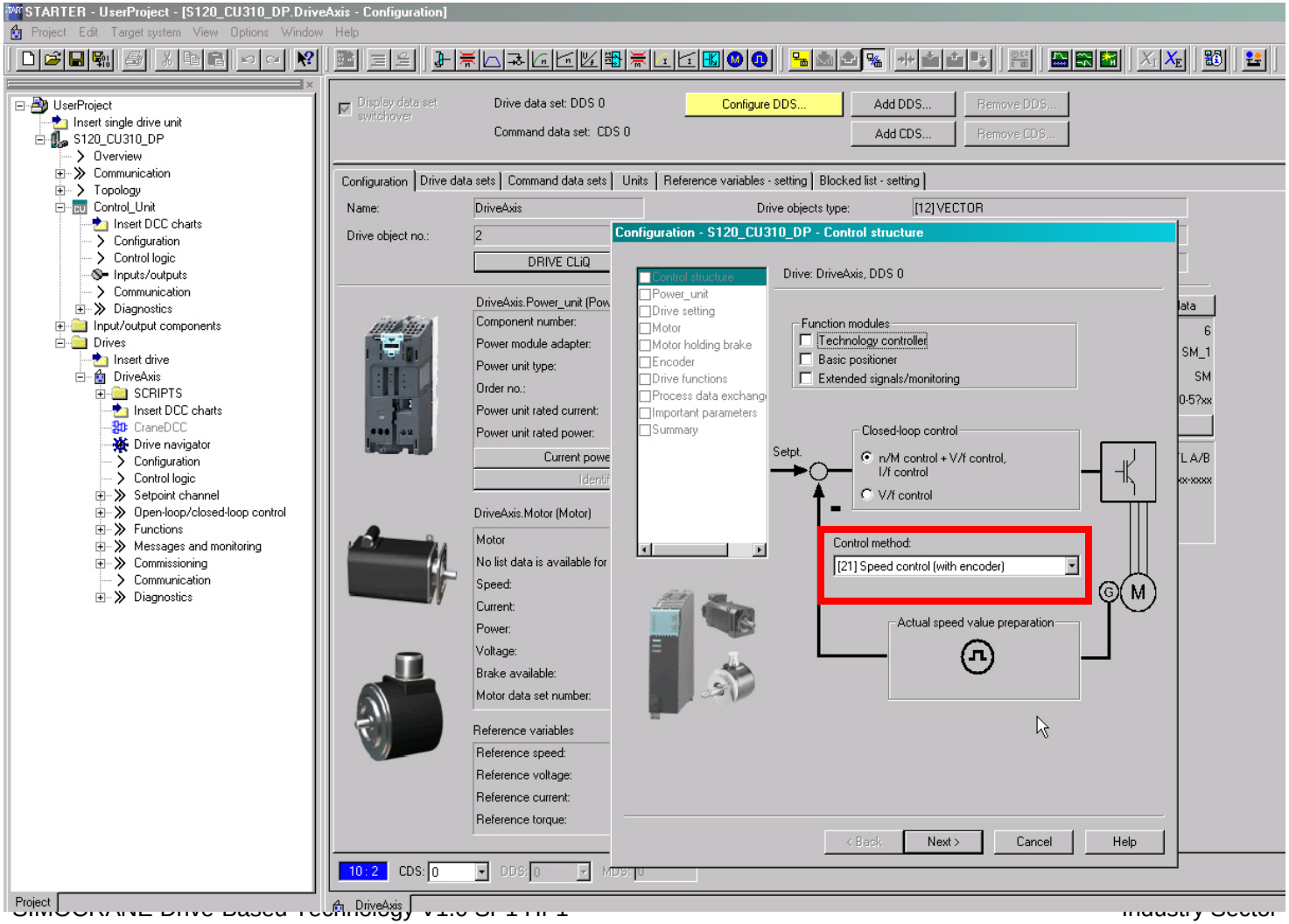
Step 2
Configuration DO



Sinamics

Select control method

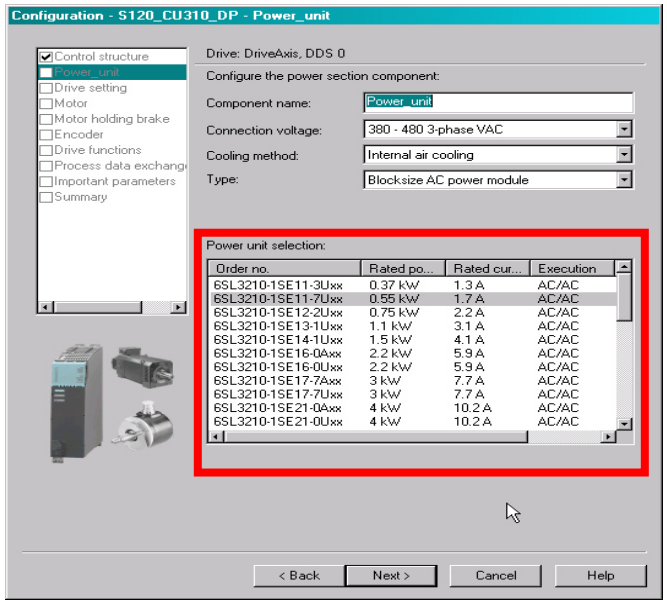
Step 2
Configuration DO

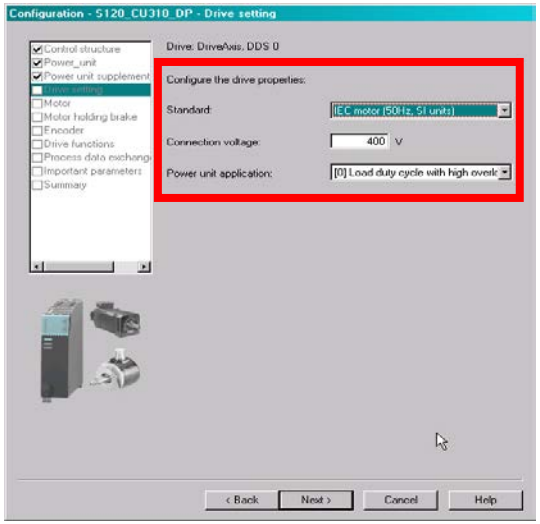


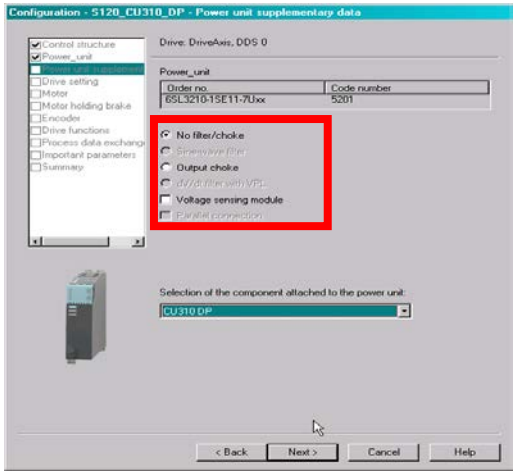
Configuring of the power unit and drive properties

Sinamics

Step 2
Configuration DO



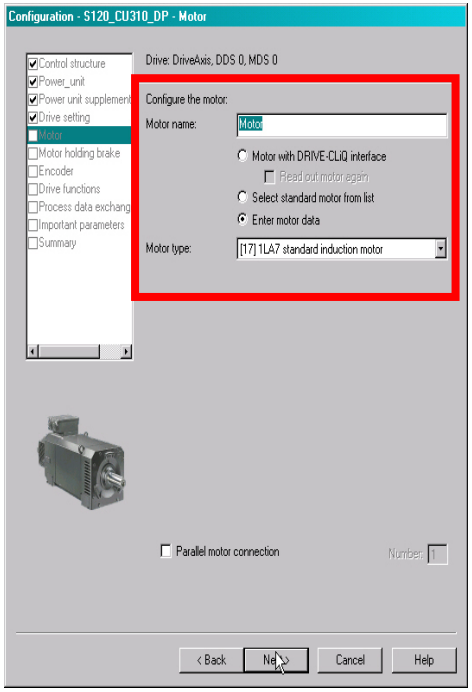


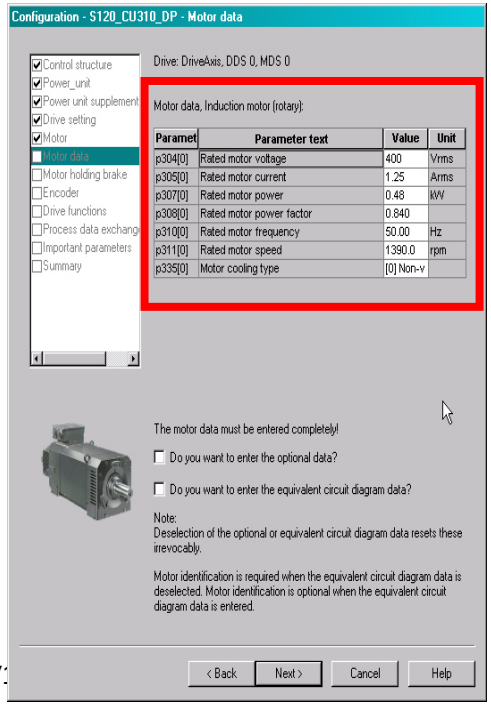


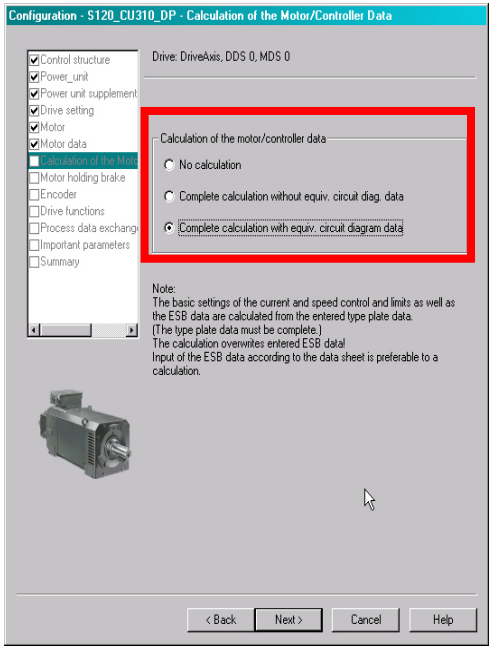
Sinamics

Configuring of motor

Step 2
Configuration DO

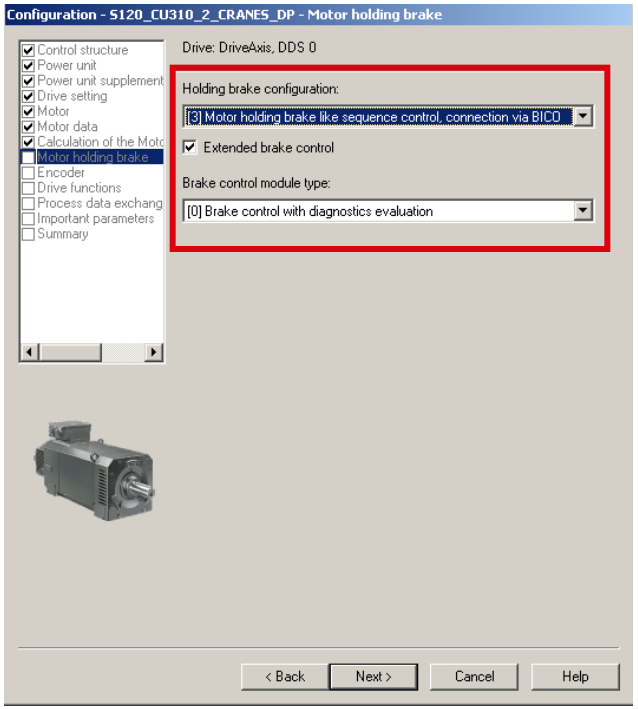


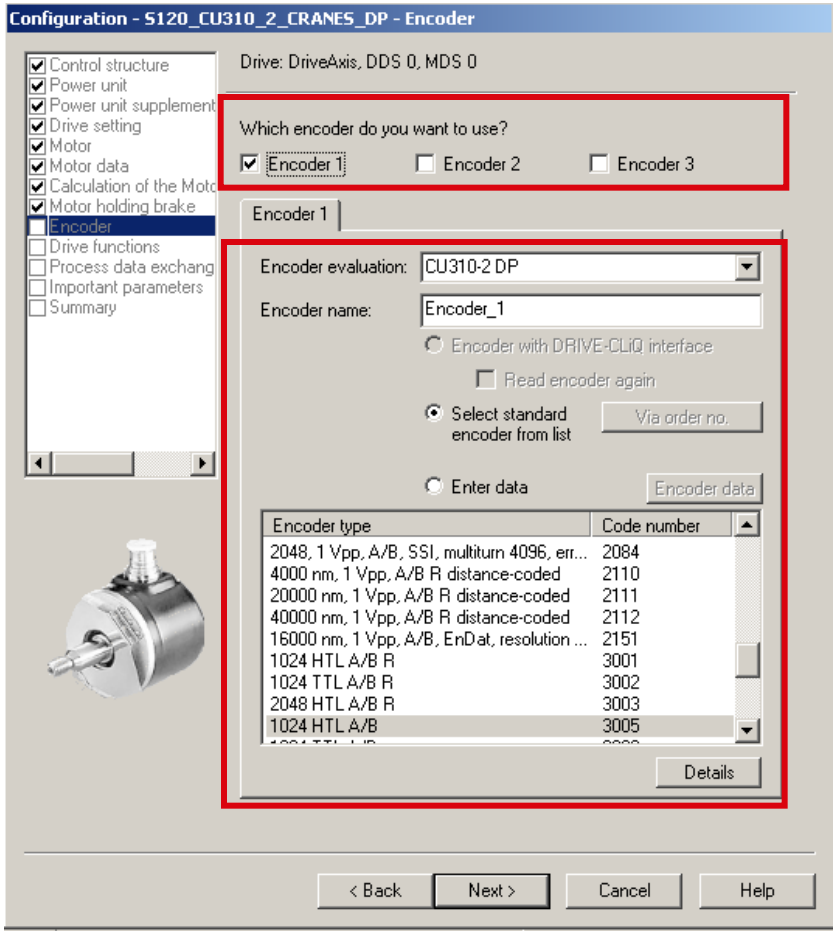




Configuring of holding brake and encoder

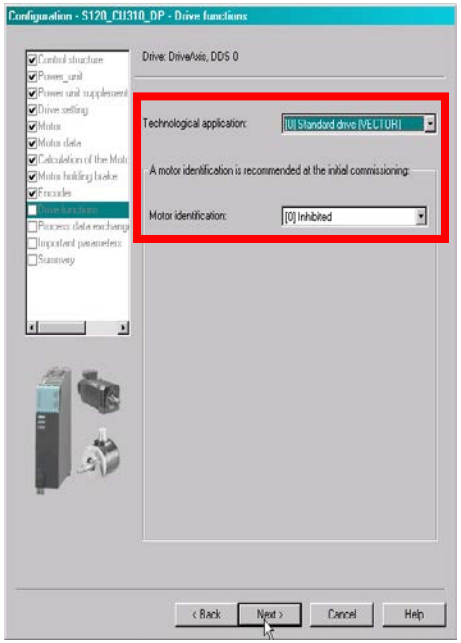
Step 2
Configuration DO

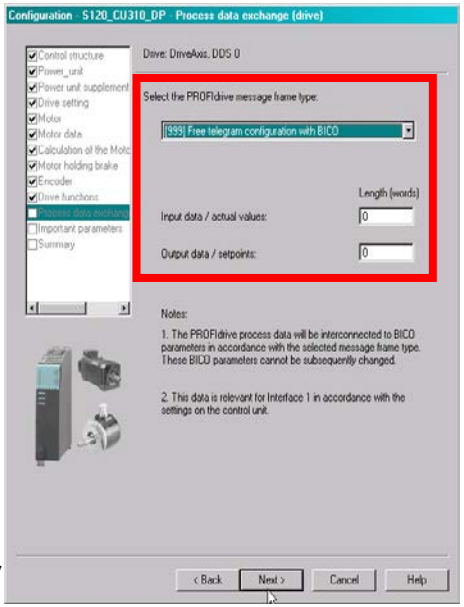


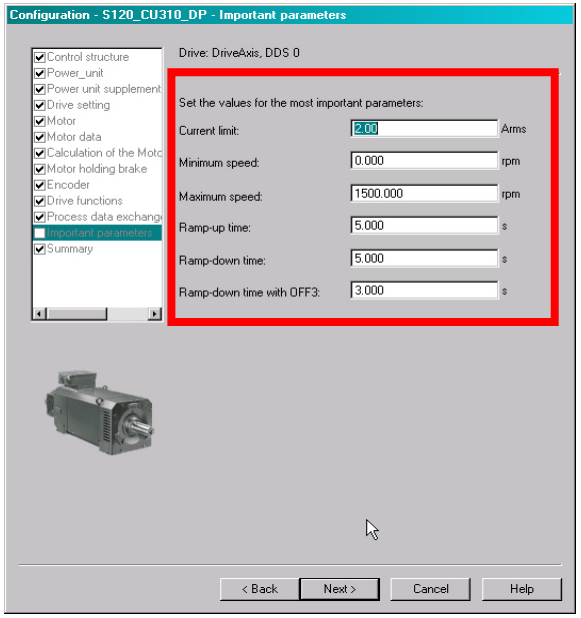


Sinamics

Select drive functions, communication frame type ..

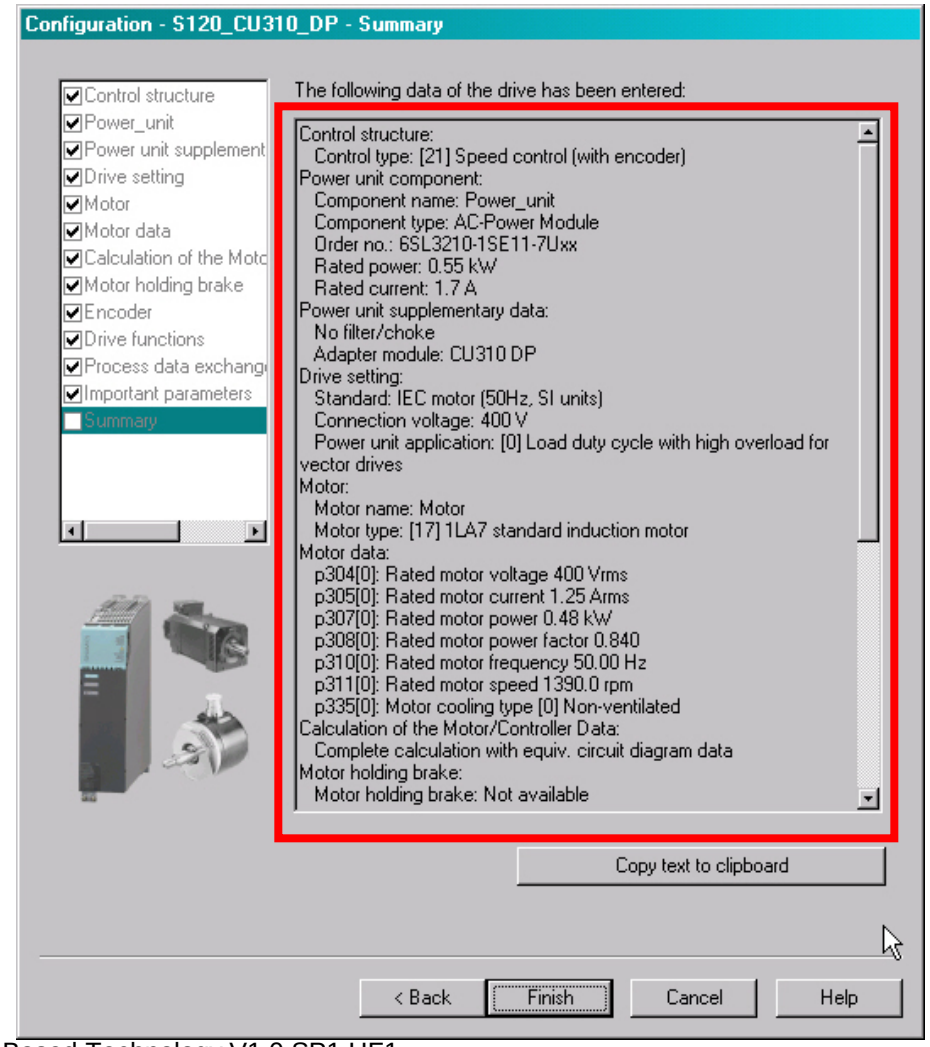






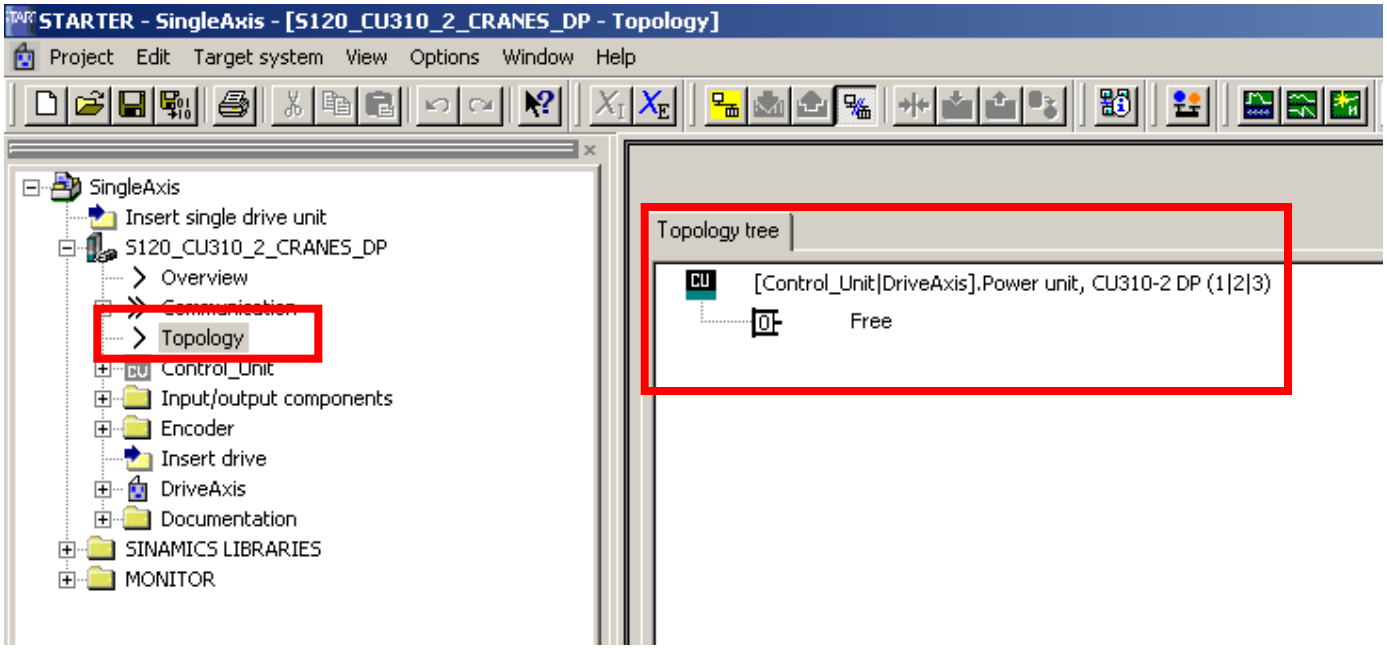
Step 2
Configuration DO

Summary



Step 2
Configuration DO

Check Topology

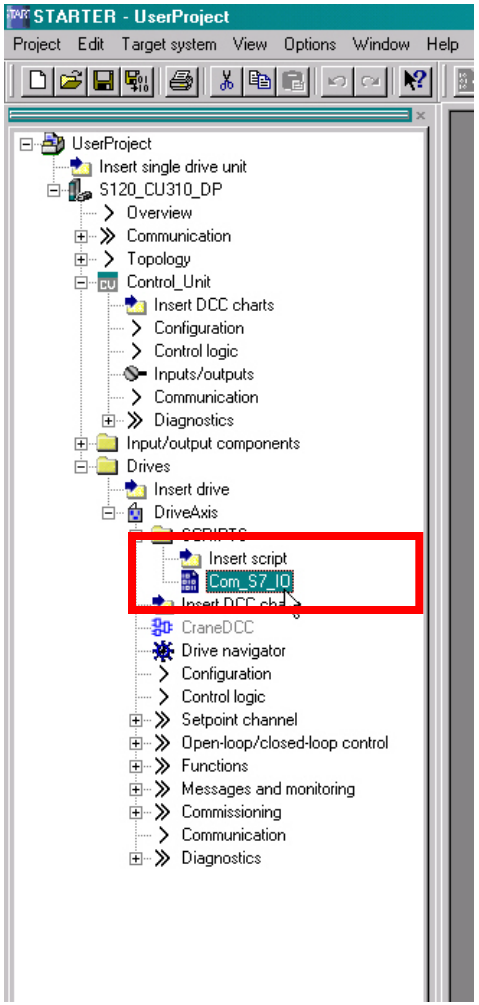


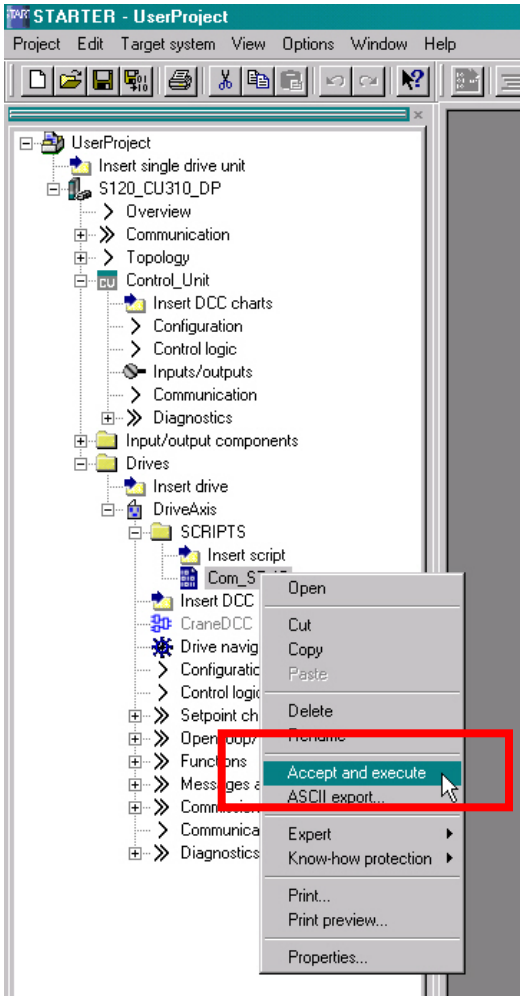
Step 2
Configuration DO

Simocrane

Execute Script file

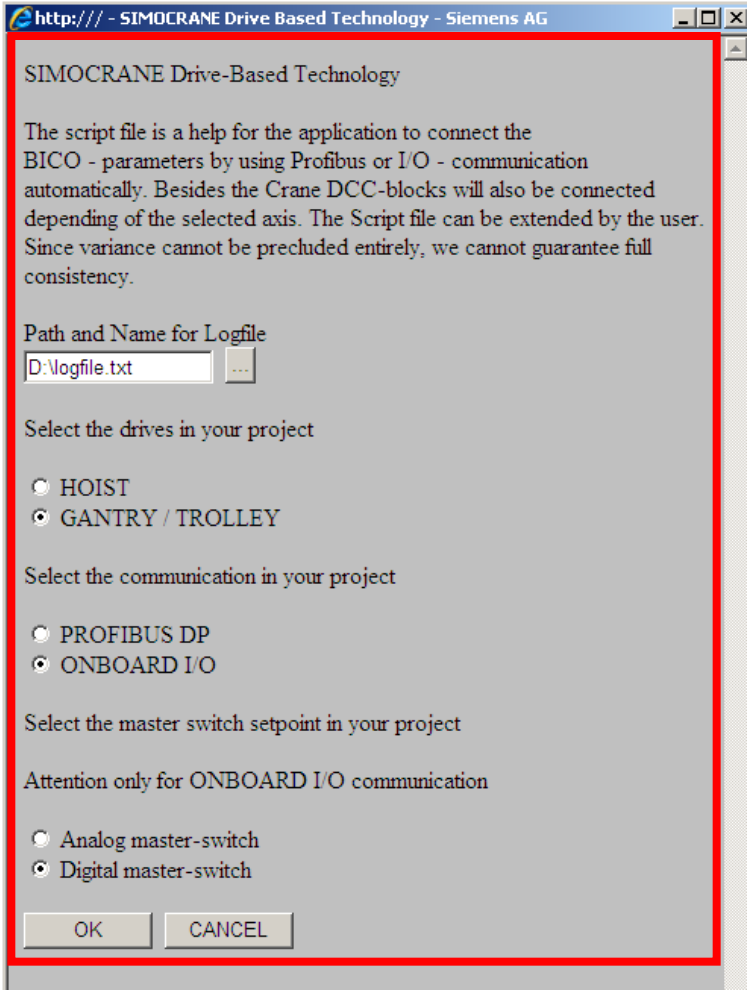
Step 3
Running Script





Script file window

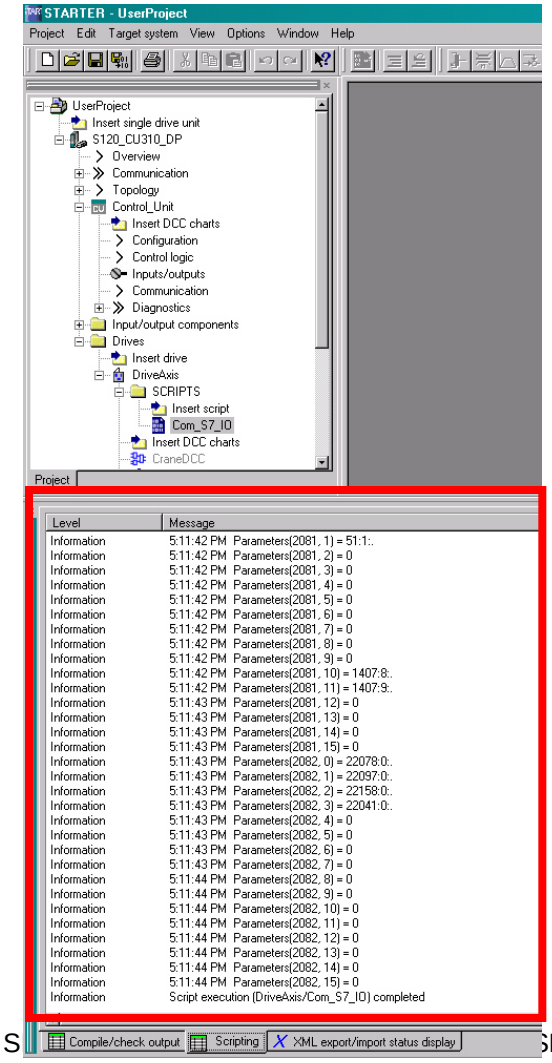
Simocrane



Step 3
Running Script

Running script

Simocrane



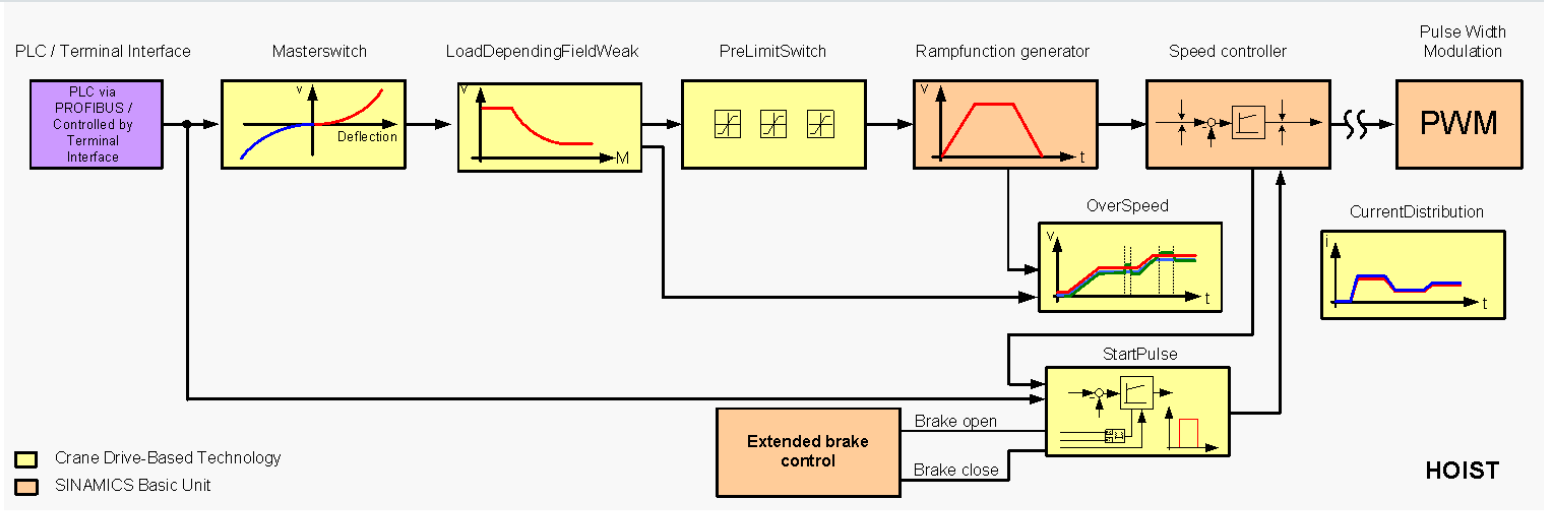
In the script window all parameter settings will be shown.

A log-file can be saved for documentation

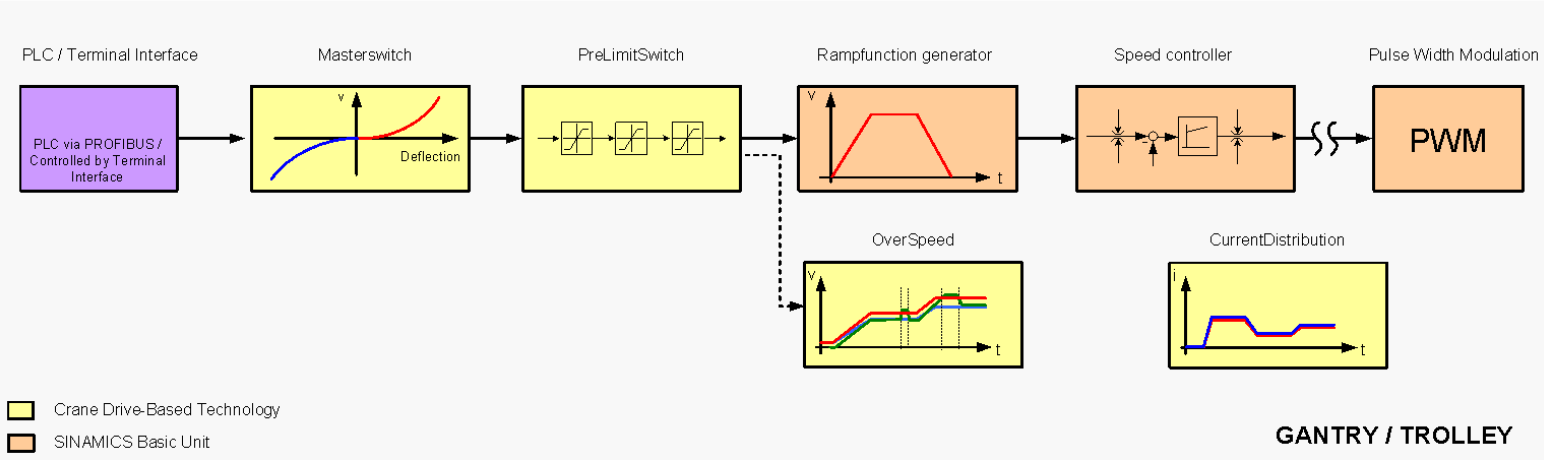
Step 3
Running Script

Setpoint channel in CU310-2 after running script (via Profibus control)

Simocrane



Step 3
Running Script



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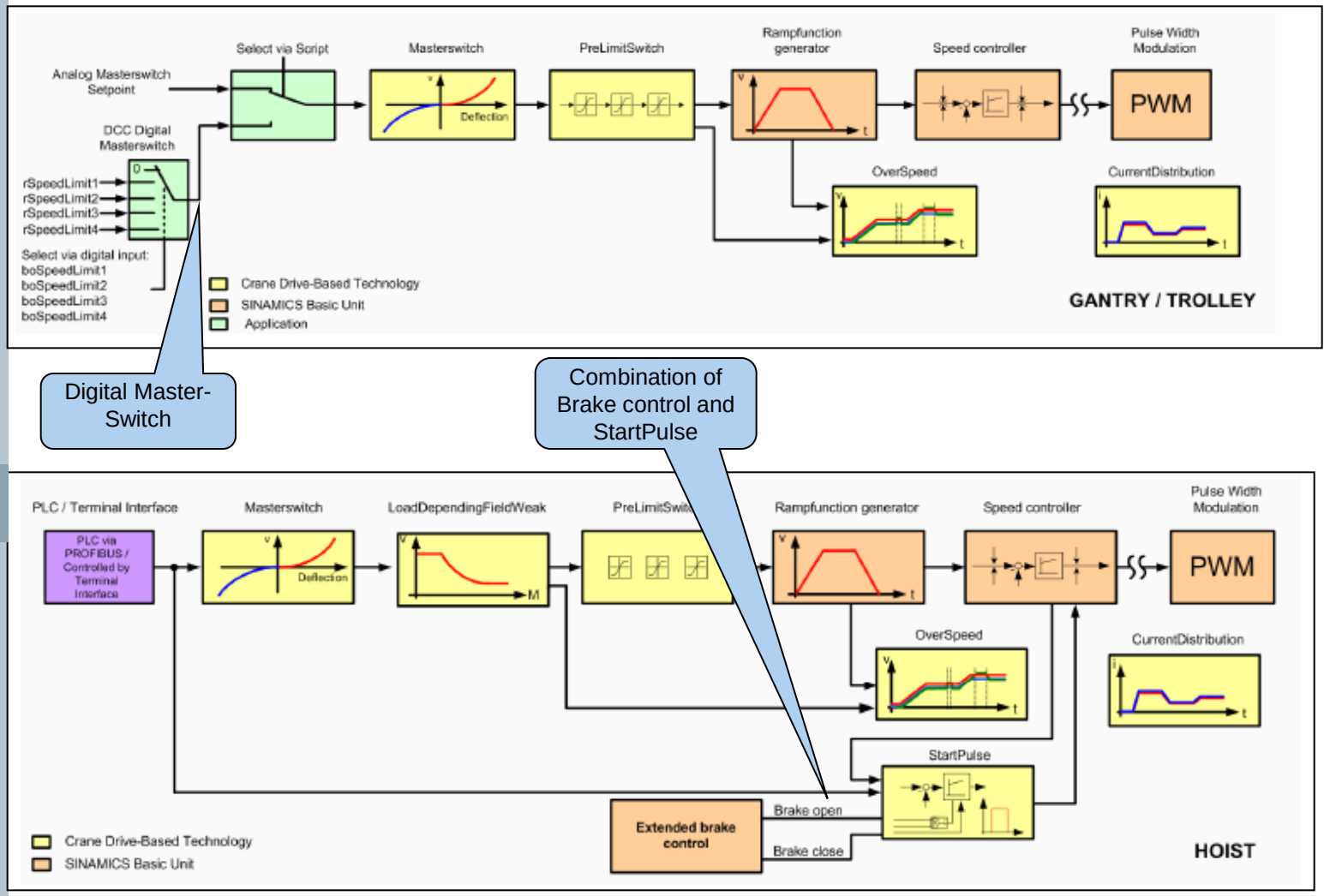
Hoist Setpoint channel in CU310-2 after running script (via Onboard I/O with digital masterswitch or Profibus control)

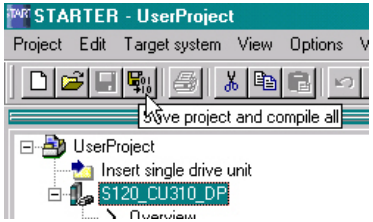
Simocrane



Step 3
Running Script

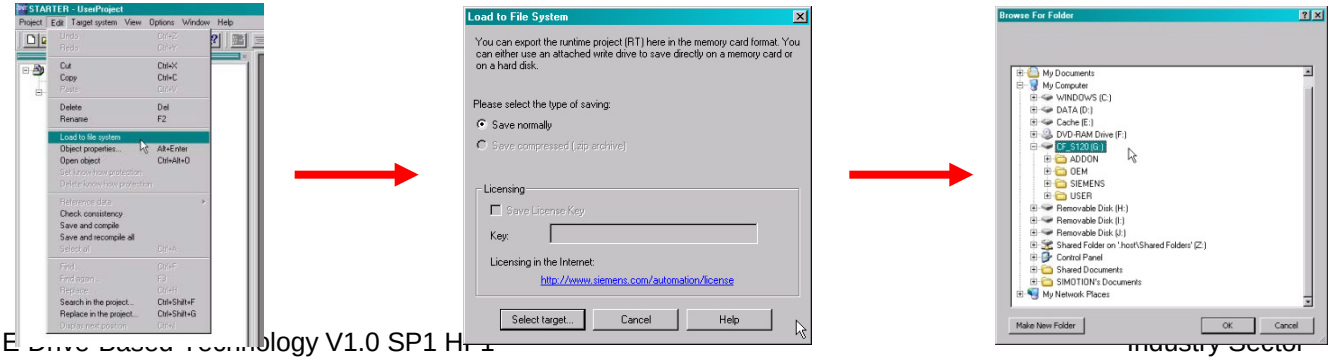
Download into CF-card

Save and compile the project and then the project can be downloaded in two ways:



1. With STARTER go online via Profibus to SINAMICS CU310-2 and download the project into the device.

2. Put the Compact Flash card into a card reader and download the project direct to the CF card and then put the CF card into the device.

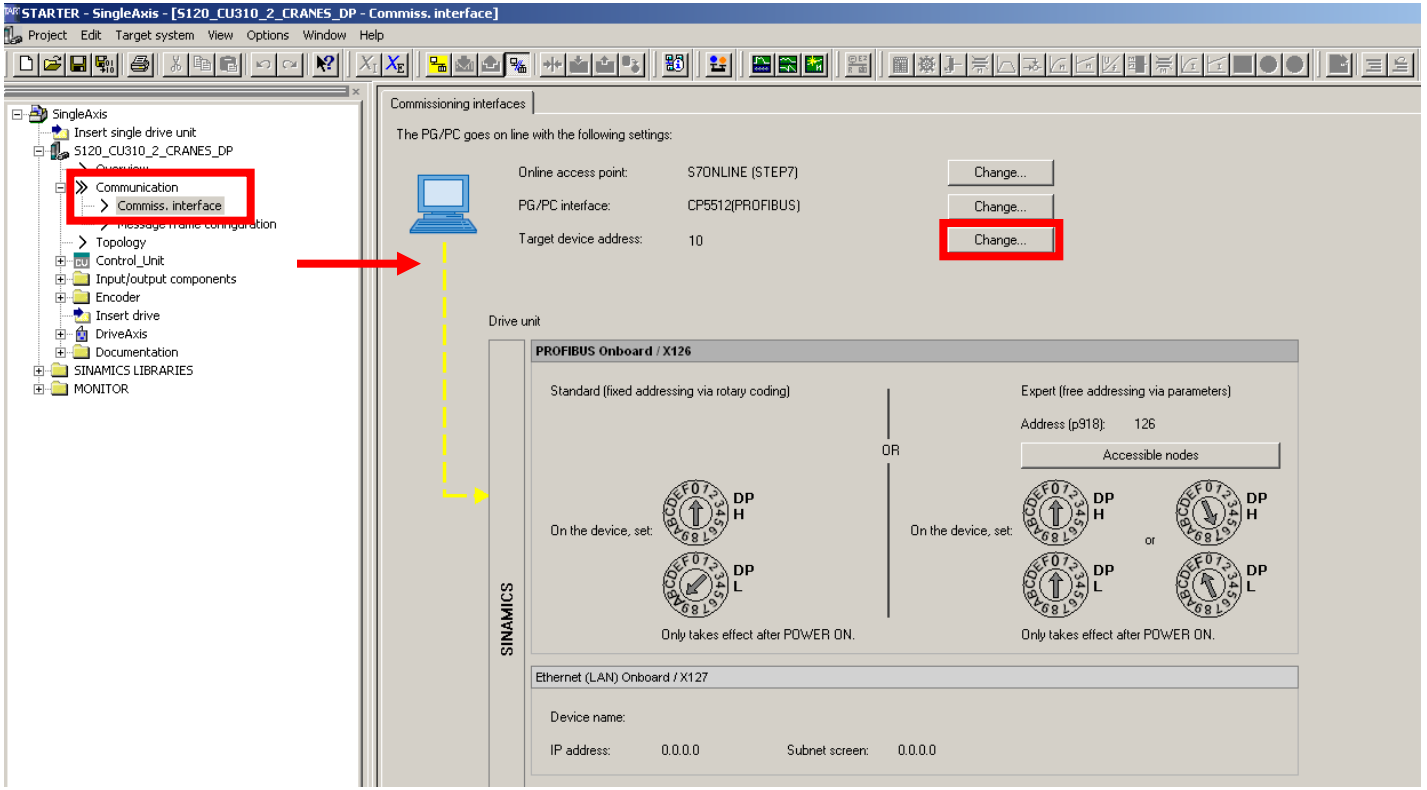


Step 3
Running Script

Communication Interface via Profibus

Sinamics

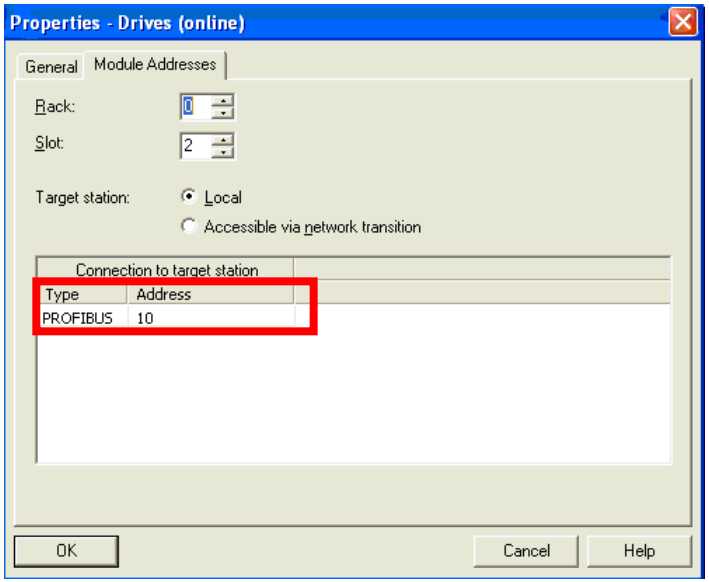
For online download the profibus address must be configured as follows:



Step 4
Motor identification

Communication Interface via Profibus

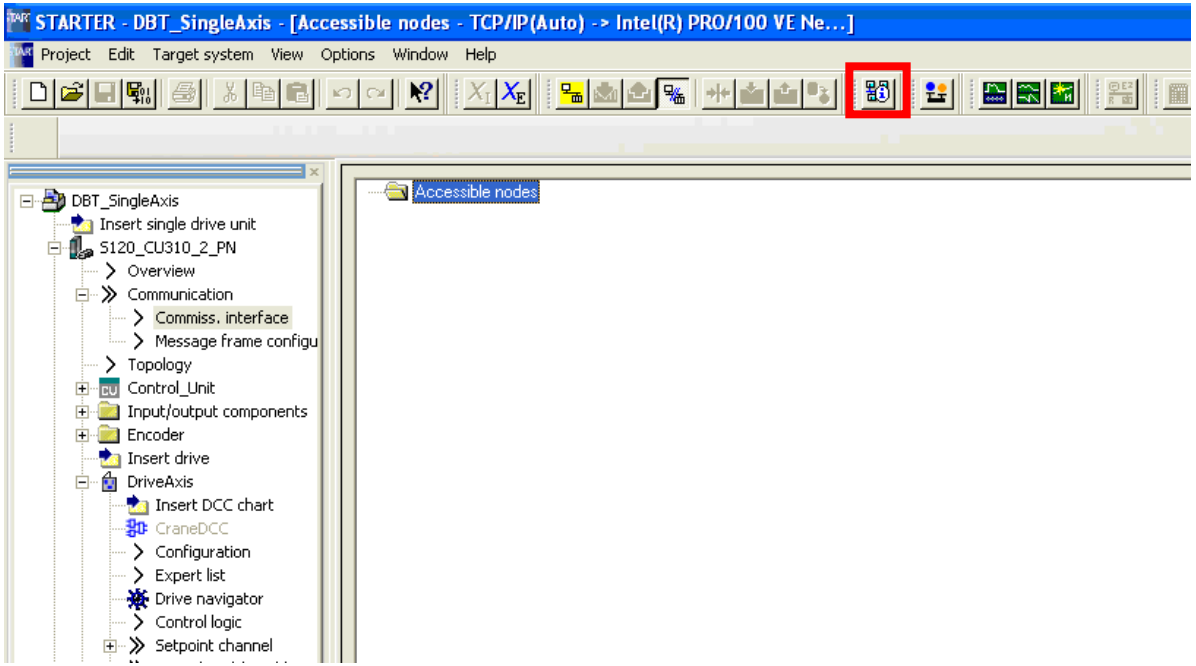
- The profibus address is entered here. (This must correspond to the profibus address found on the CU310-2)



- The profibus address can be set on the CU310-2 by setting the switches found underneath the BOP.

Communication interface via Ethernet (1)

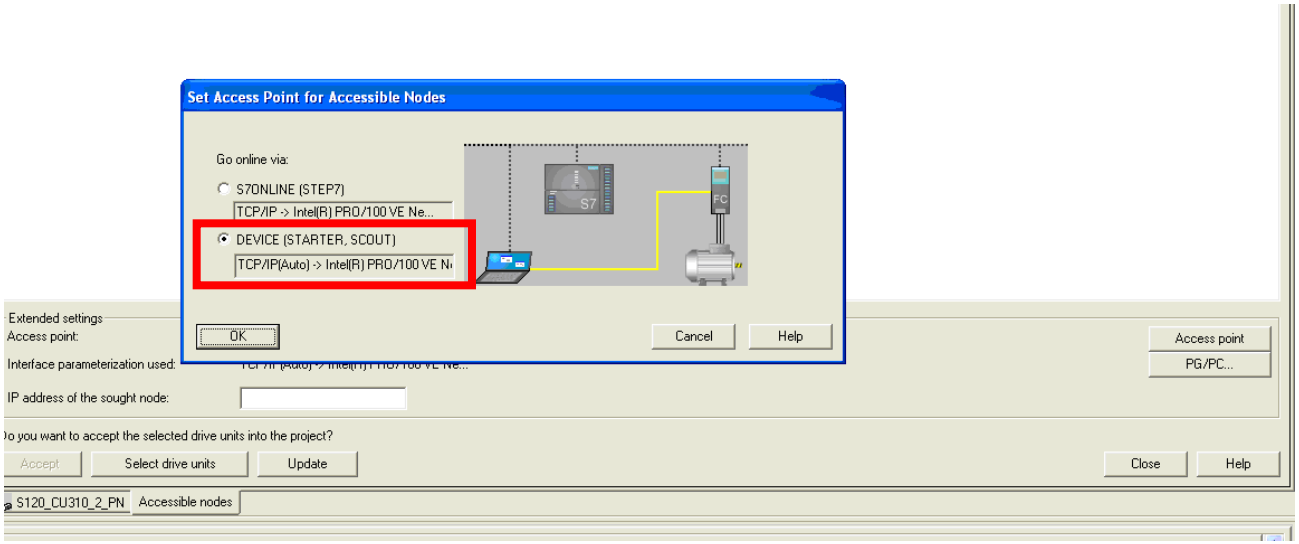
- For using an Ethernet connection to connect to the control unit select the accessible nodes button to find device.



Step 4
Motor identification

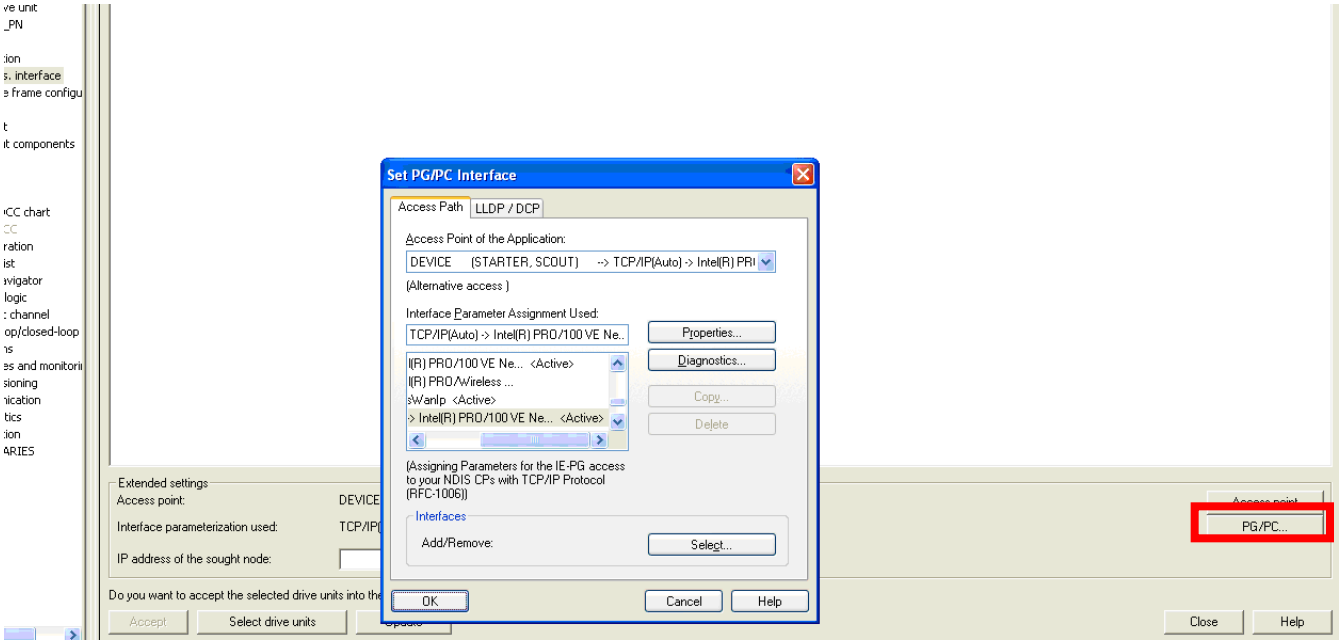
Communication interface via Ethernet (2)

- If the device is not found immediately:
  1. Set access point to device in the accessible nodes tab.



Communication interface via Ethernet (3)

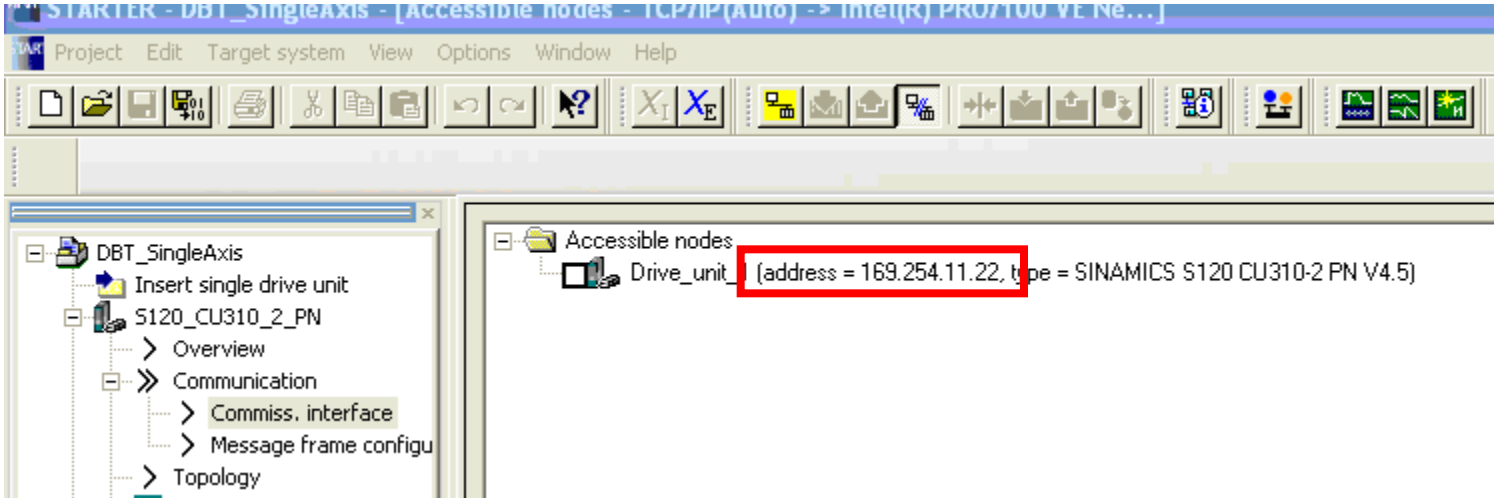
2. Set the PG/PC interface in the accessible nodes tab. (Tip: Select component which has <Active> written after it).



Step 4
Motor identification

Communication interface via Ethernet (4)

3. Select search for accessible nodes again.
4. When the device is found note the IP address.



Communication interface via Ethernet (5)

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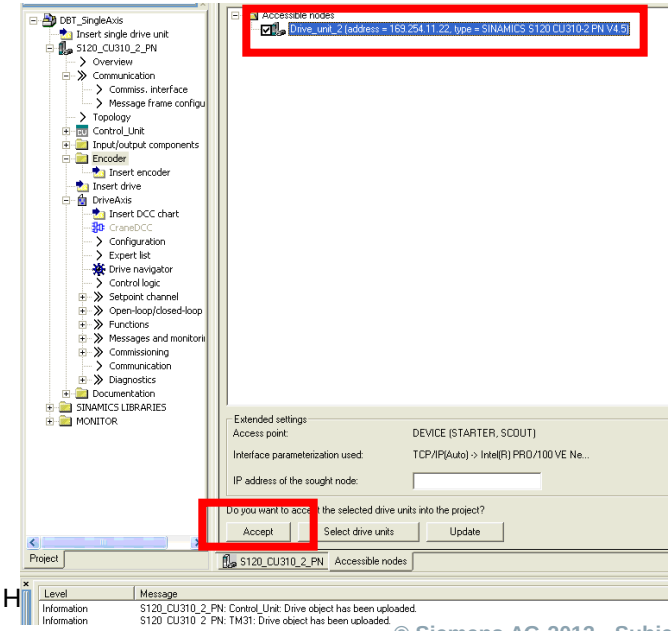
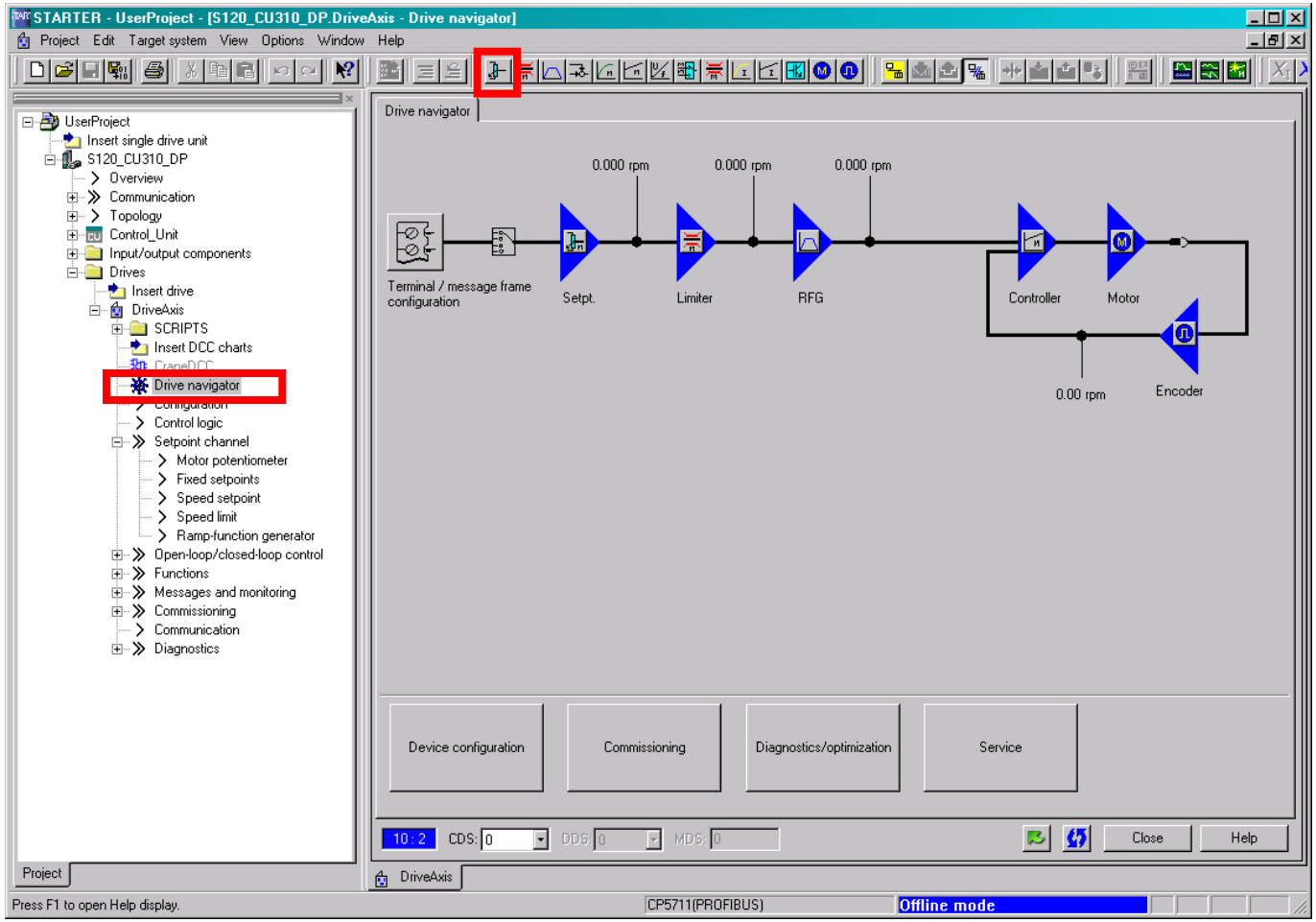
5. Adjust the PG/PC IP address so that it will have the same first 3 numbers as the address of the device but with a different fourth number. (E. g. If the device address is 169.254.11.22 then the PC/PG address should be changed accordingly to an address with the same first 3 numbers but a different fourth e. g. 169.254.11.1)
6. Highlight device in accessible nodes tab and accept device into project.



Step 4
Motor identification

Overview of drive navigator

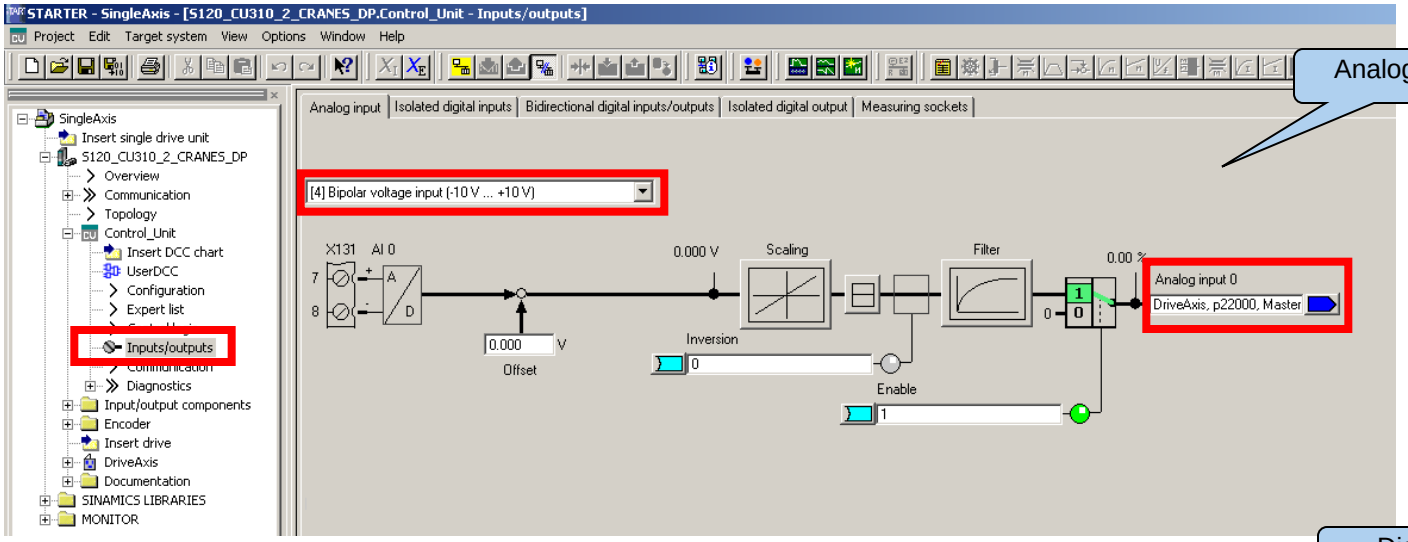
Sinamics

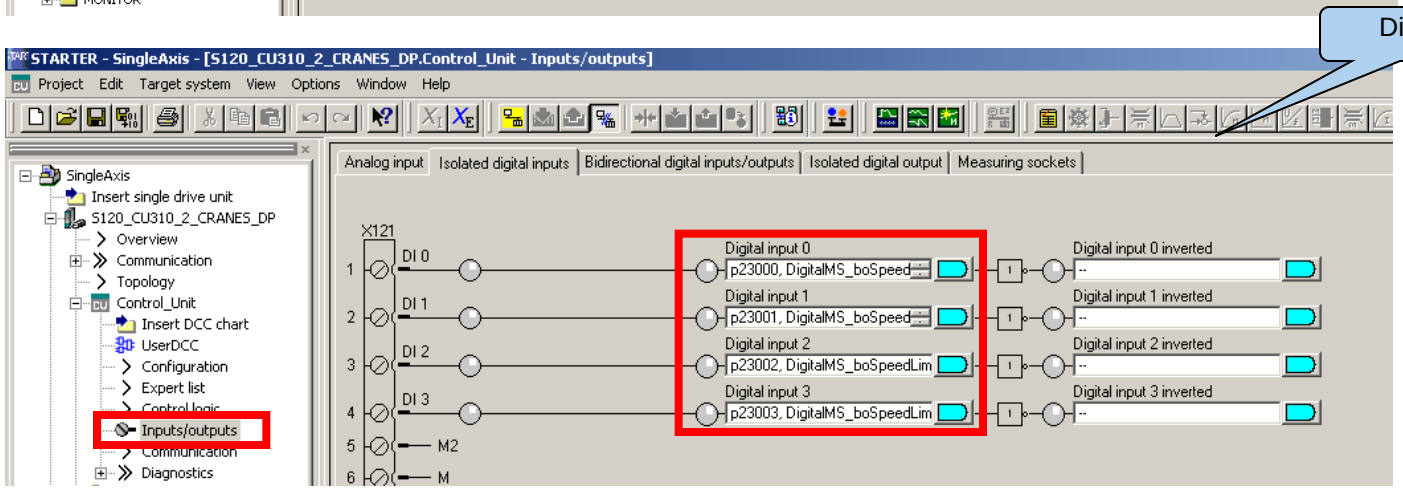


Step 4
Motor identification

Sinamics

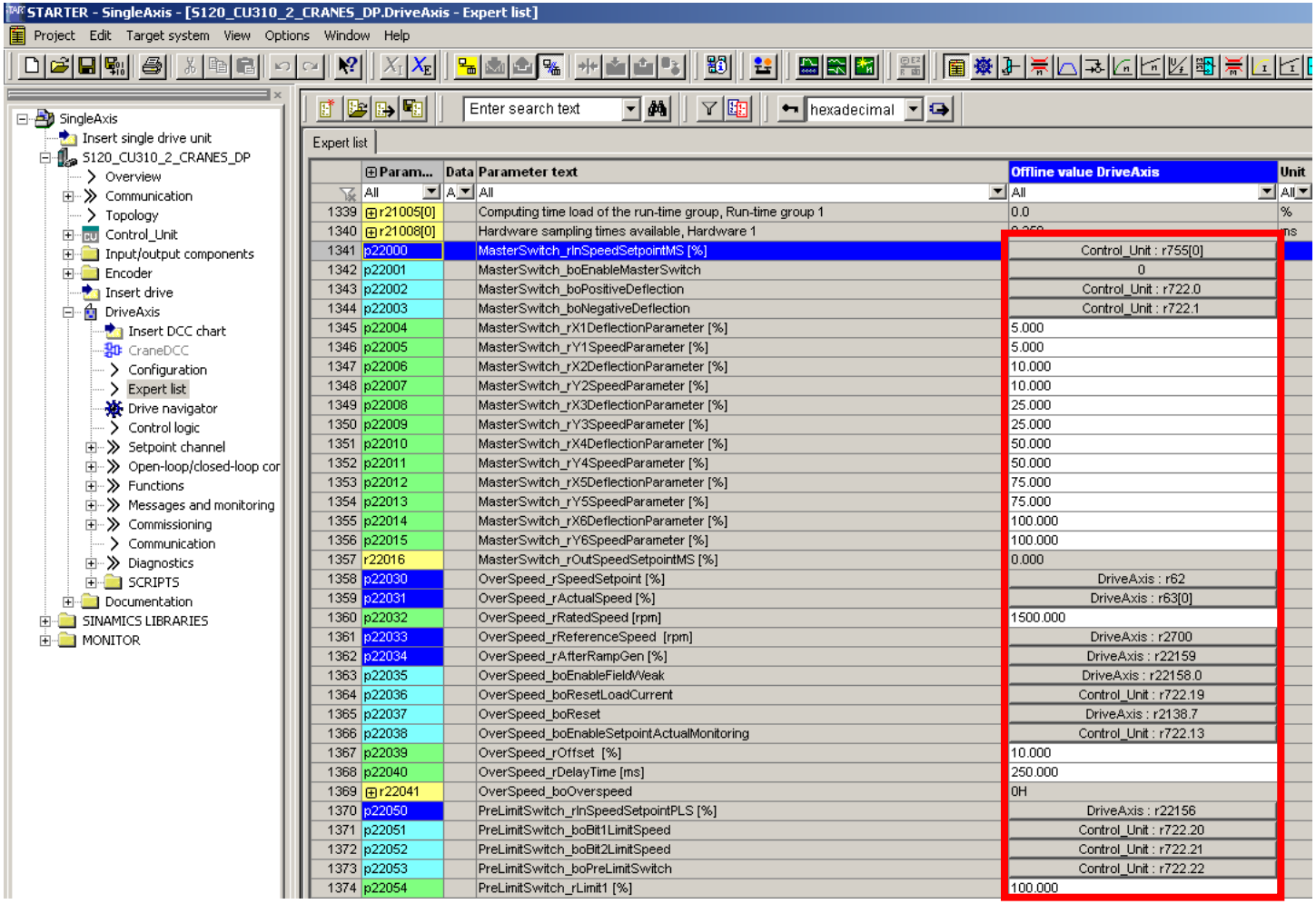
Overview of I/O-Signals





Step 4
Motor identification

Overview of parameter list

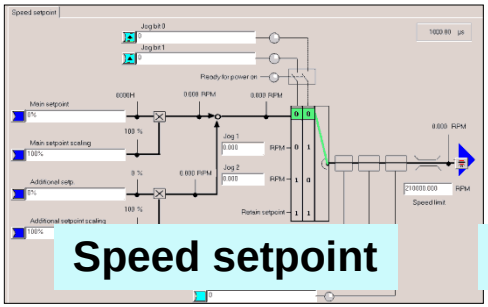


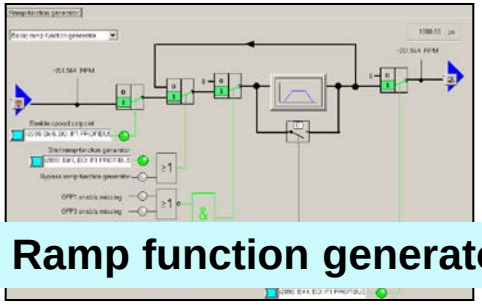
	Param...	Data	Parameter text	Offline value DriveAxis	Unit
1339	r21005[0]		Computing time load of the run-time group, Run-time group 1	0.0	%
1340	r21008[0]		Hardware sampling times available, Hardware 1		ns
1341	p22000		MasterSwitch_rInSpeedSetpointMS [%]	Control_Unit : r755[0]	
1342	p22001		MasterSwitch_boEnableMasterSwitch	0	
1343	p22002		MasterSwitch_boPositiveDeflection	Control_Unit : r722.0	
1344	p22003		MasterSwitch_boNegativeDeflection	Control_Unit : r722.1	
1345	p22004		MasterSwitch_rX1DeflectionParameter [%]	5.000	
1346	p22005		MasterSwitch_rY1SpeedParameter [%]	5.000	
1347	p22006		MasterSwitch_rX2DeflectionParameter [%]	10.000	
1348	p22007		MasterSwitch_rY2SpeedParameter [%]	10.000	
1349	p22008		MasterSwitch_rX3DeflectionParameter [%]	25.000	
1350	p22009		MasterSwitch_rY3SpeedParameter [%]	25.000	
1351	p22010		MasterSwitch_rX4DeflectionParameter [%]	50.000	
1352	p22011		MasterSwitch_rY4SpeedParameter [%]	50.000	
1353	p22012		MasterSwitch_rX5DeflectionParameter [%]	75.000	
1354	p22013		MasterSwitch_rY5SpeedParameter [%]	75.000	
1355	p22014		MasterSwitch_rX6DeflectionParameter [%]	100.000	
1356	p22015		MasterSwitch_rY6SpeedParameter [%]	100.000	
1357	r22016		MasterSwitch_rOutSpeedSetpointMS [%]	0.000	
1358	p22030		OverSpeed_rSpeedSetpoint [%]	DriveAxis : r62	
1359	p22031		OverSpeed_rActualSpeed [%]	DriveAxis : r63[0]	
1360	p22032		OverSpeed_rRatedSpeed [rpm]	1500.000	
1361	p22033		OverSpeed_rReferenceSpeed [rpm]	DriveAxis : r2700	
1362	p22034		OverSpeed_rAfterRampGen [%]	DriveAxis : r22159	
1363	p22035		OverSpeed_boEnableFieldWeak	DriveAxis : r22158.0	
1364	p22036		OverSpeed_boResetLoadCurrent	Control_Unit : r722.19	
1365	p22037		OverSpeed_boReset	DriveAxis : r2138.7	
1366	p22038		OverSpeed_boEnableSetpointActualMonitoring	Control_Unit : r722.13	
1367	p22039		OverSpeed_rOffset [%]	10.000	
1368	p22040		OverSpeed_rDelayTime [ms]	250.000	
1369	r22041		OverSpeed_boOverspeed	0H	
1370	p22050		PreLimitSwitch_rInSpeedSetpointPLS [%]	DriveAxis : r22156	
1371	p22051		PreLimitSwitch_boBit1LimitSpeed	Control_Unit : r722.20	
1372	p22052		PreLimitSwitch_boBit2LimitSpeed	Control_Unit : r722.21	
1373	p22053		PreLimitSwitch_boPreLimitSwitch	Control_Unit : r722.22	
1374	p22054		PreLimitSwitch_rLimit1 [%]	100.000	

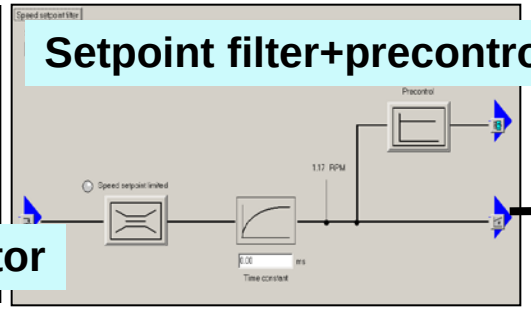
Step 4
Motor identification

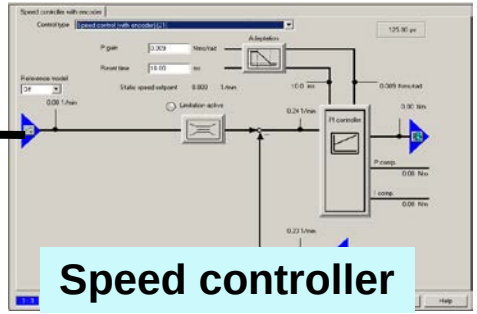
Mainstream of speed setpoint and closed-loop control

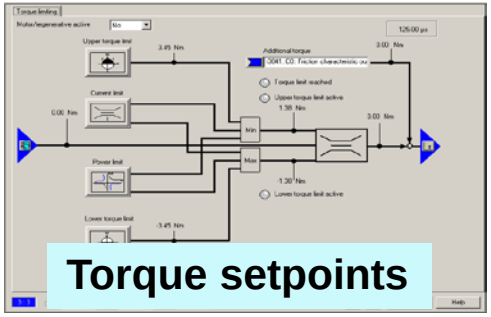
Sinamics

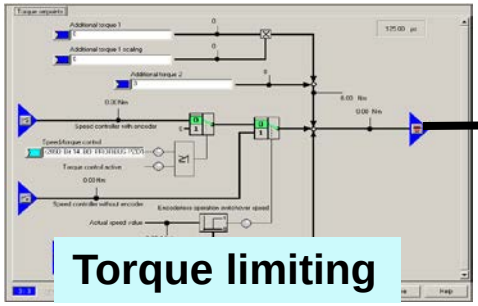


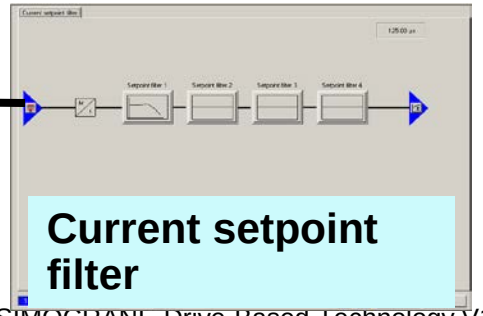


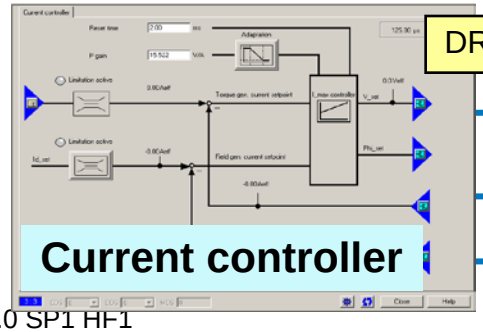




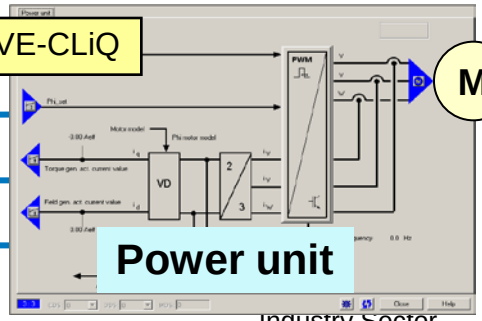








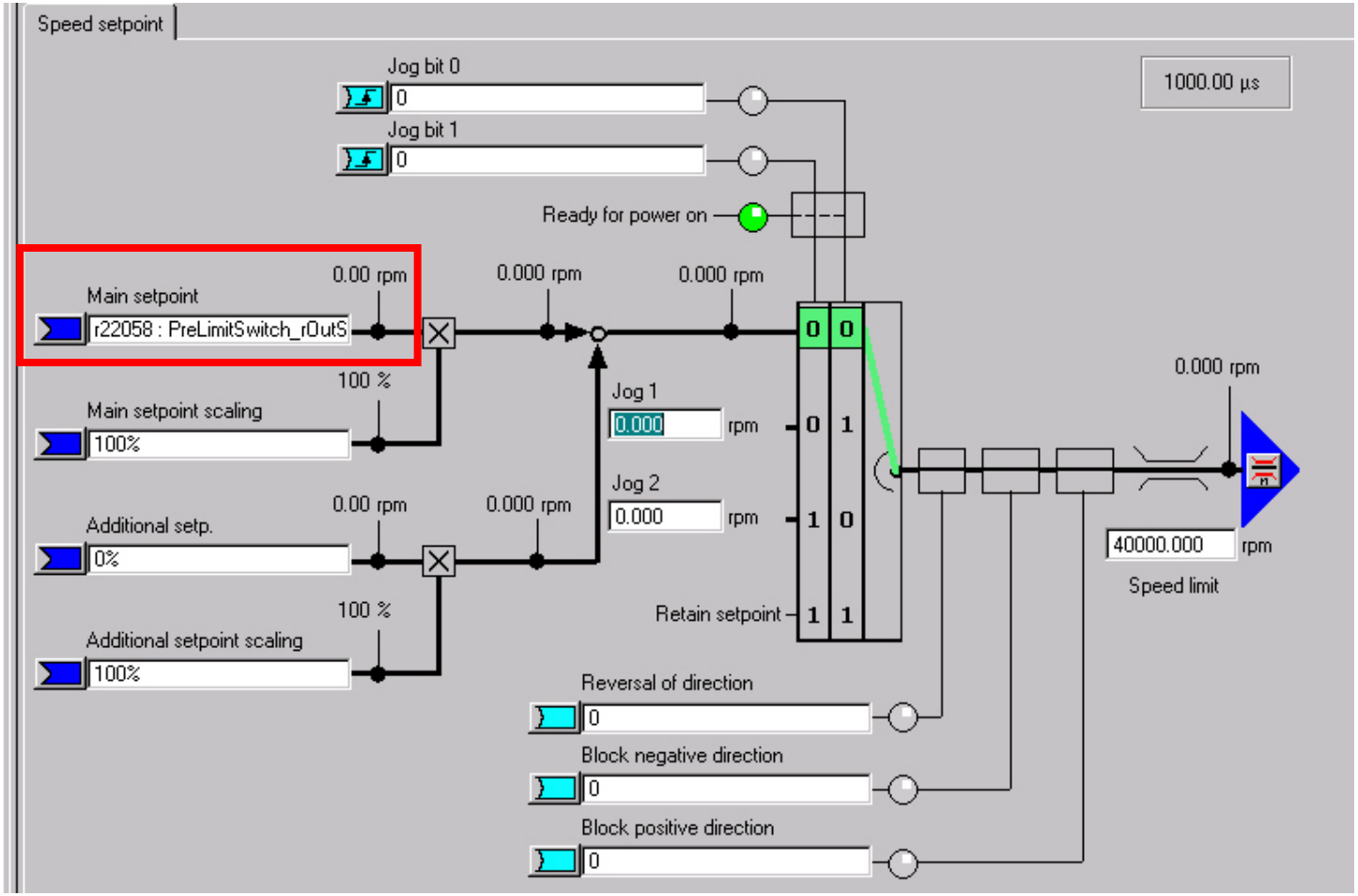
DRIVE-CLiQ



Step 4
Motor identification

Speed setpoint

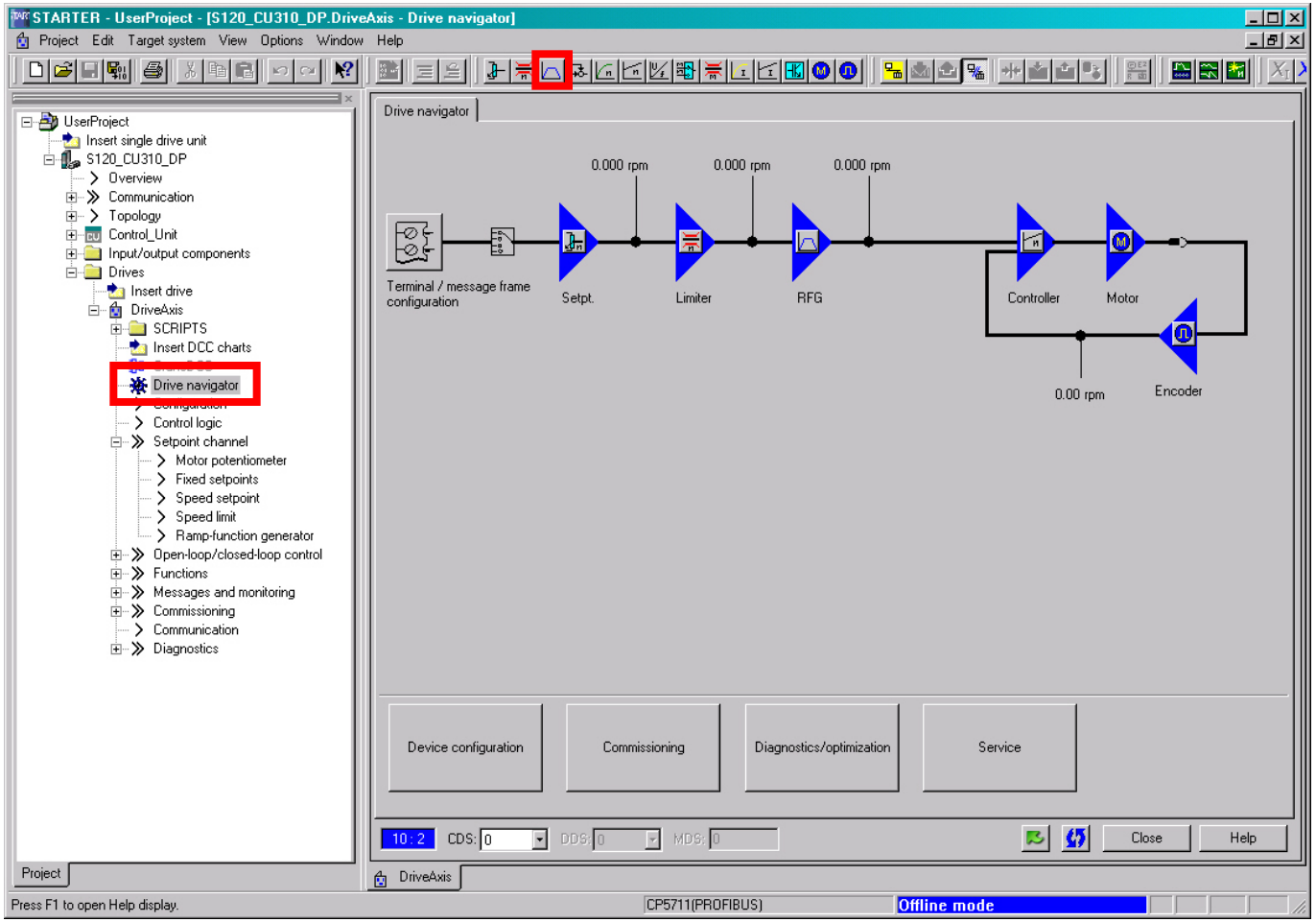
Sinamics



Step 4
Motor identification

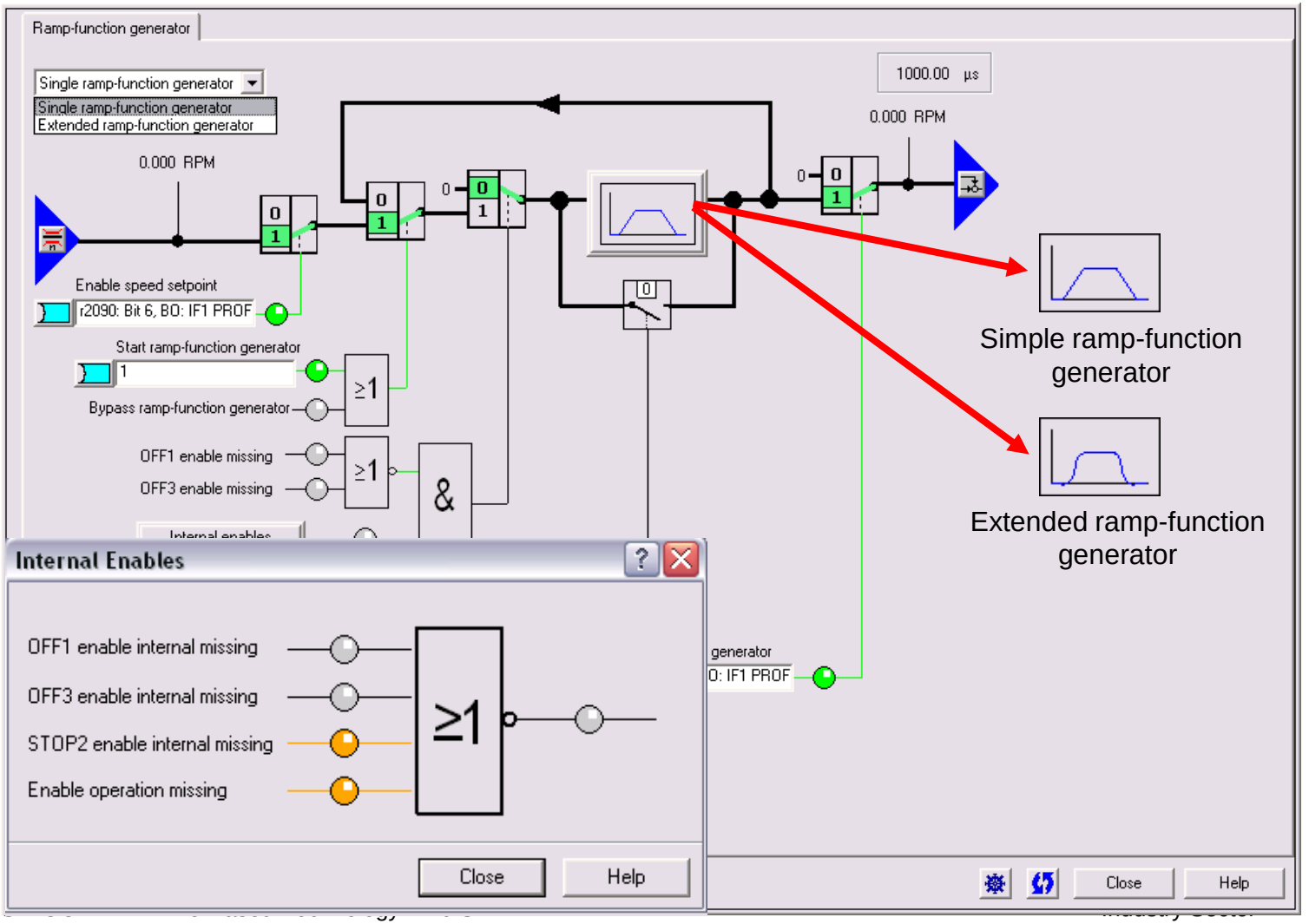
Ramp-function generator

Sinamics



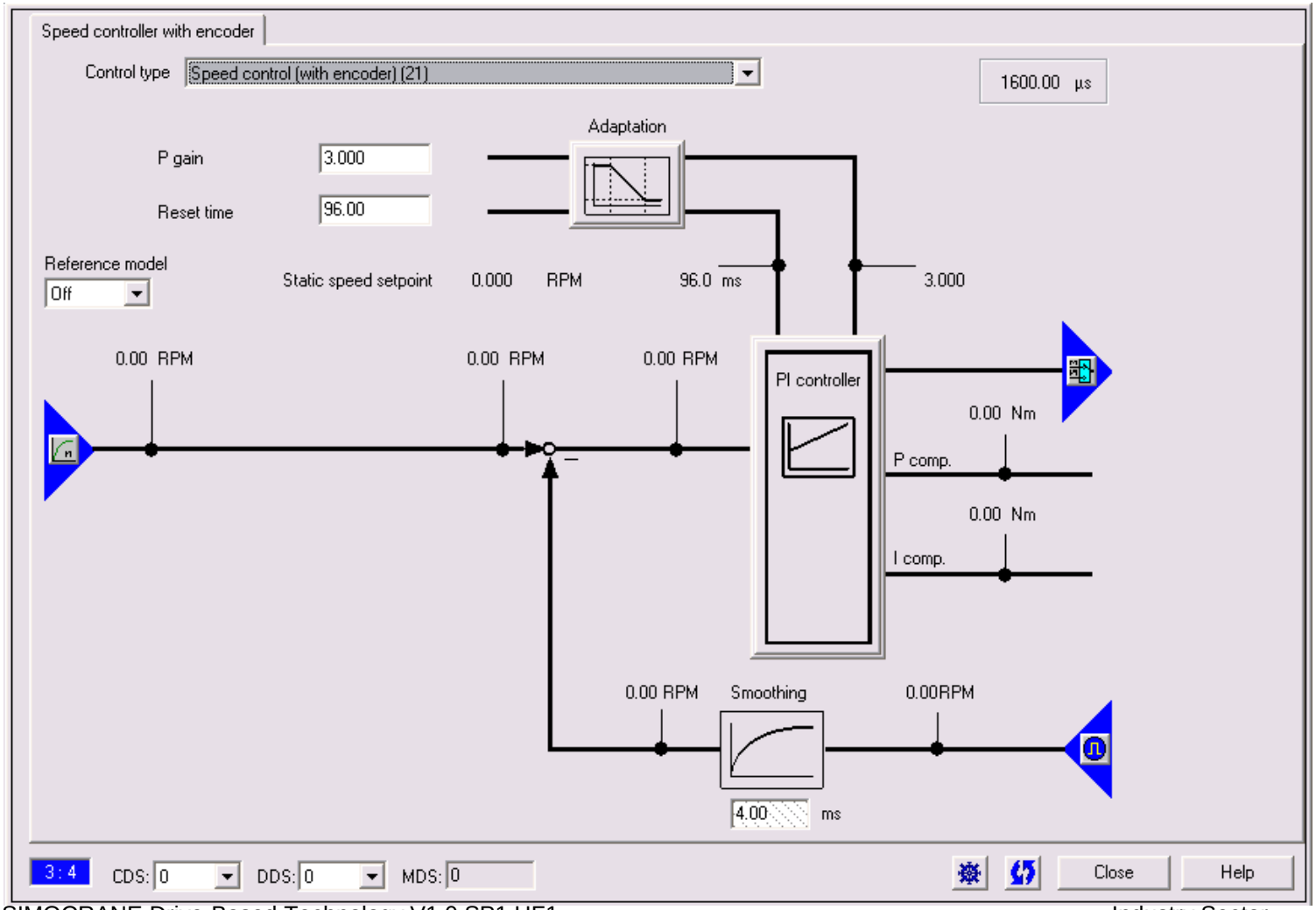
Step 4
Motor identification

Ramp-function generator



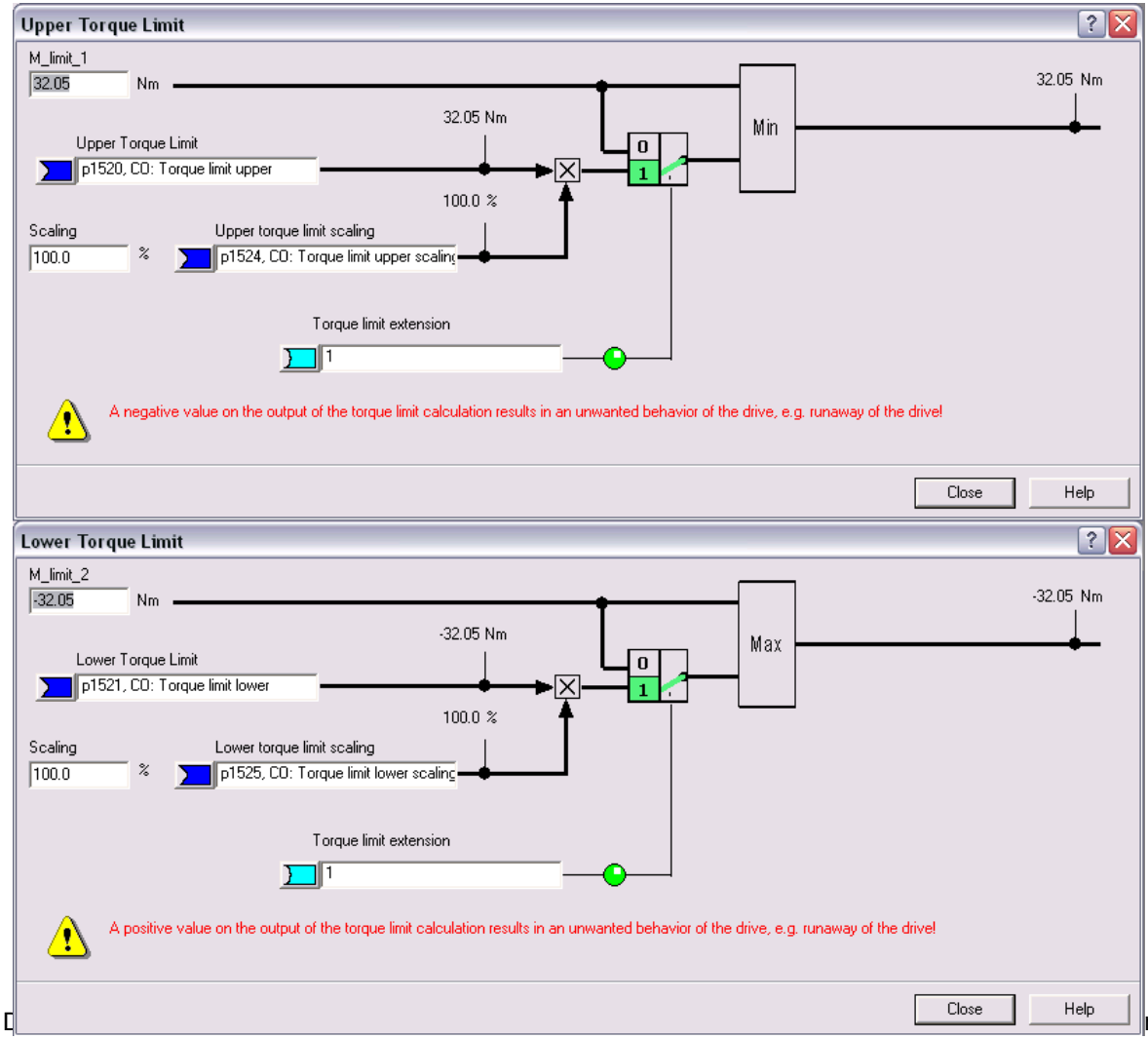
Step 4
Motor identification

Speed controller



Step 4
Motor identification

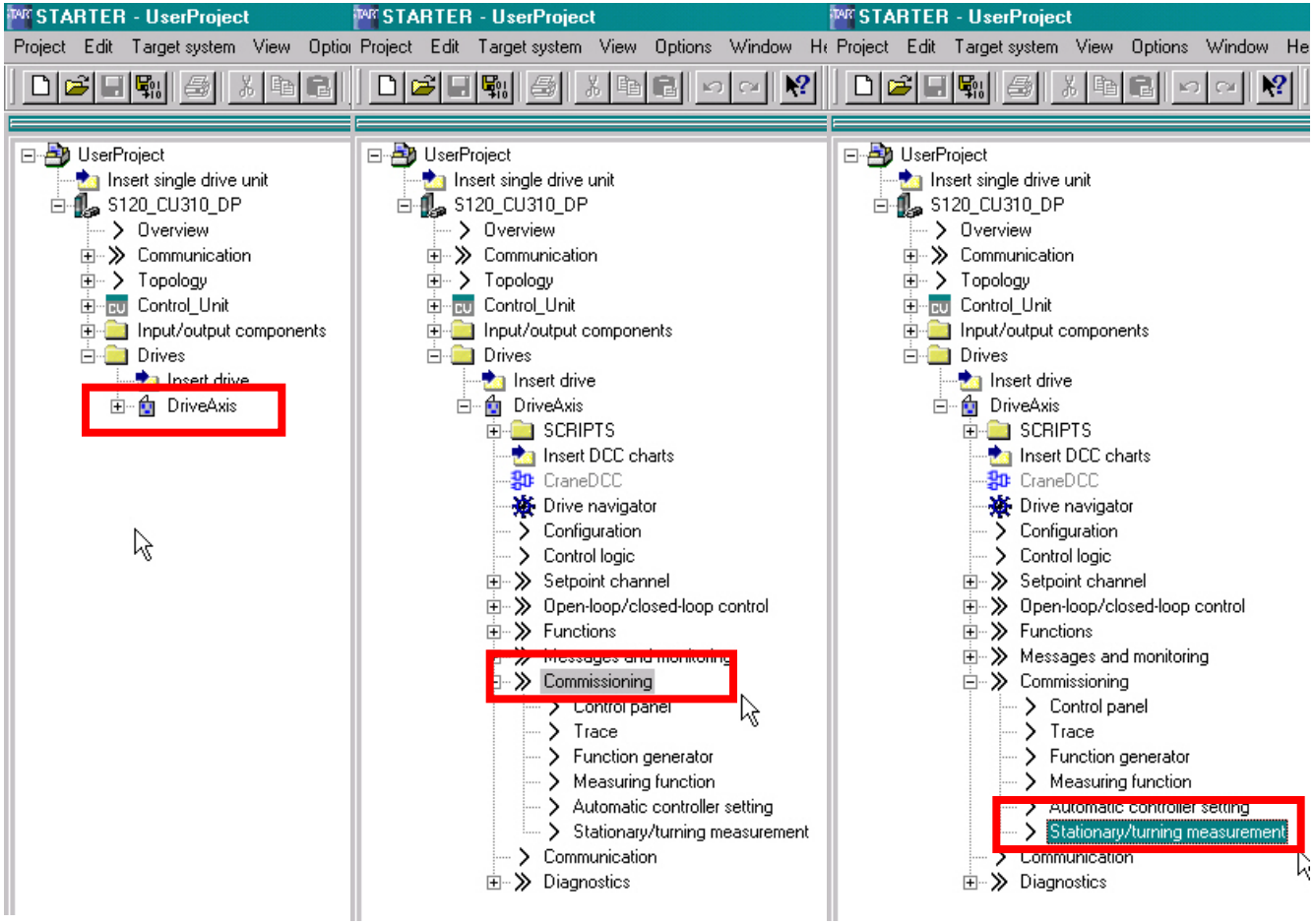
Upper and Lower Torque Limit



Step 4
Motor identification

Introduction stationary measurement

Sinamics

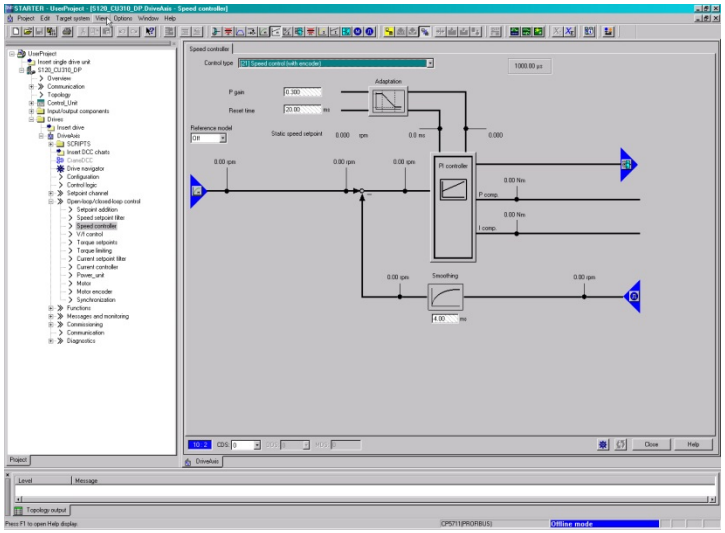


Step 4
Motor identification

Purpose of stationary measurement (refer to Chapter 6.3)

Sinamics

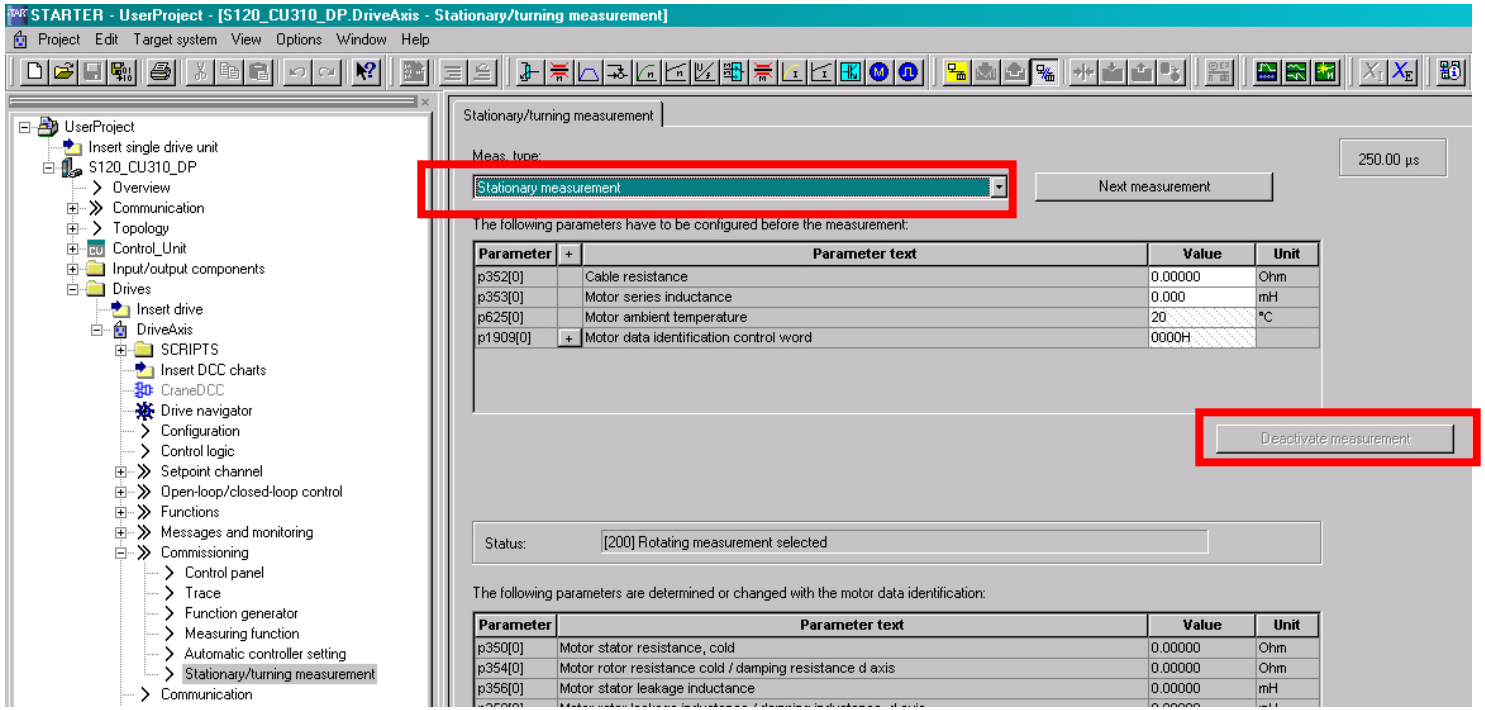
- SINAMICS Drive Object
  - Stationary measurement
    - Equivalent circuit diagram data
    - Total resistance for:
      - power cable resistance and
      - stator resistance
    - IGBT on-state voltage or compensation for the IGBT lockout times
  - Control Panel (speed direction check, if necessary directional change, p1821)



Sinamics

Start stationary measurement

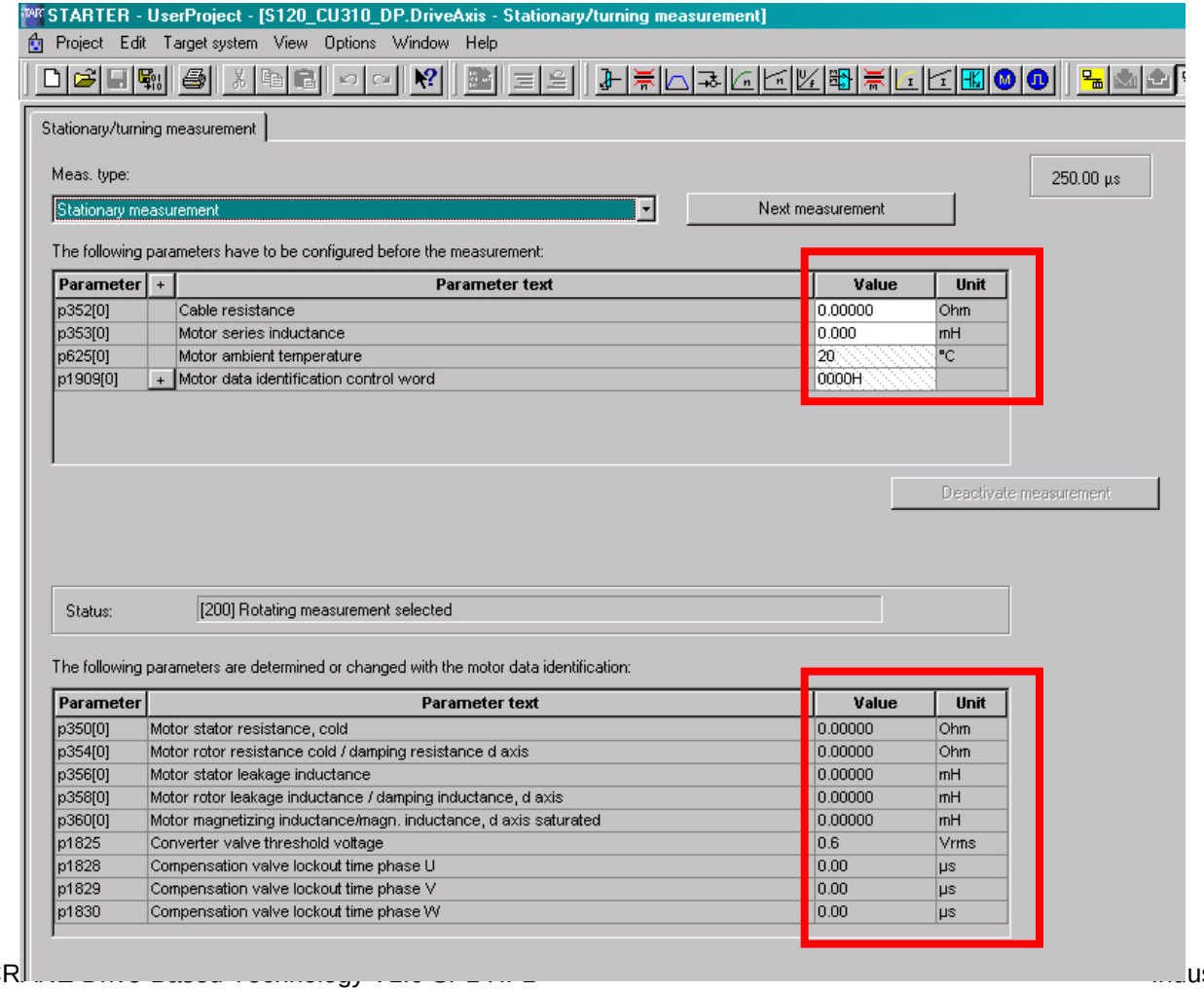
1. Select stationery measurement from the drop down menu.
2. Activate measurement.



Step 4
Motor identification

Sinamics

Results of the stationary measurement

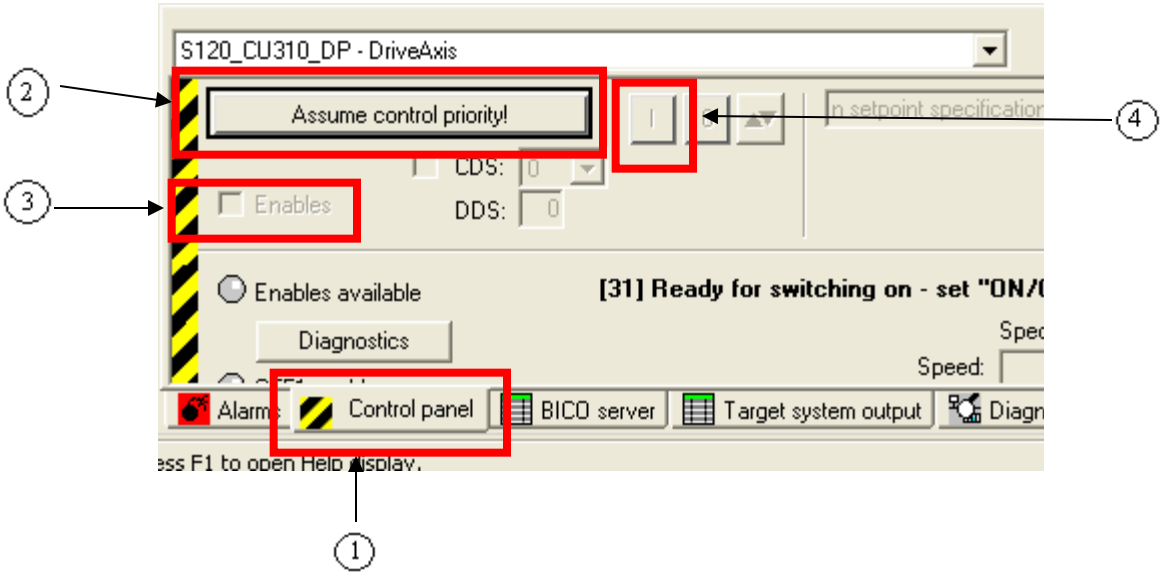


Step 4
Motor identification

Sinamics

Start stationary measurement

1. Select control panel.
2. Select assume control priority.
3. Tick the enables box.
4. Select the green I button and the test begins.

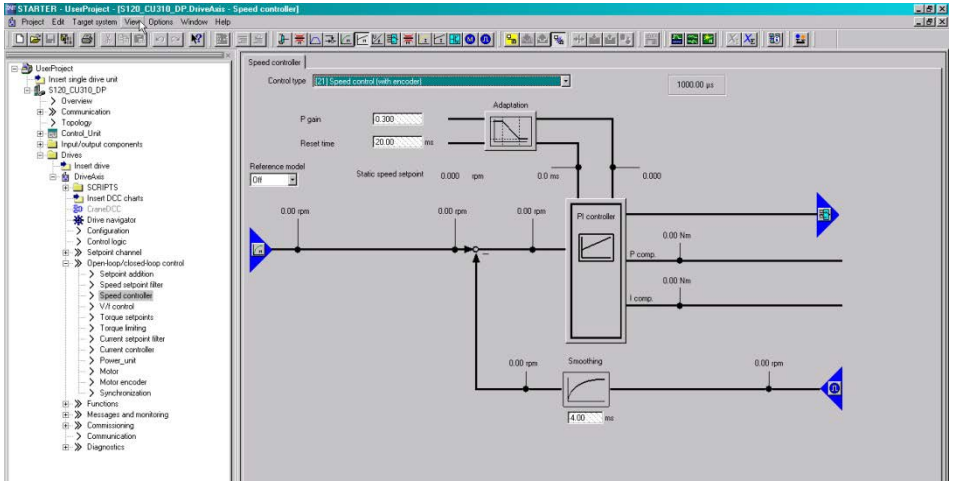


Step 4
Motor identification

Purpose of rotating measurement (refer to Chapter 6.3)

Sinamics

- SINAMICS Drive Object
  - Rotating Measurement and Speed Controller Optimization
    - Measurement of magnetization characteristic
    - Measurement of magnetization current
    - Speed controller optimization
    - Acceleration pre-control setting
    - Setting for ratio between the total moment of inertia and that for the motor



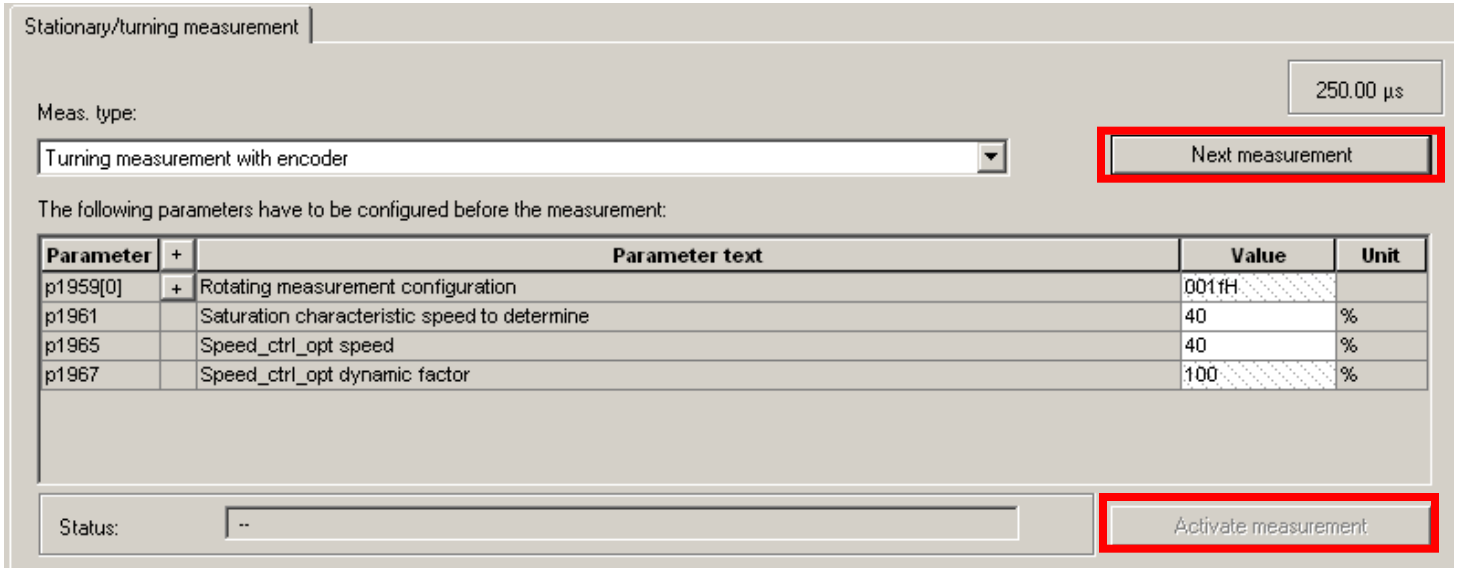
Step 4
Motor identification

Sinamics

Start turning measurement

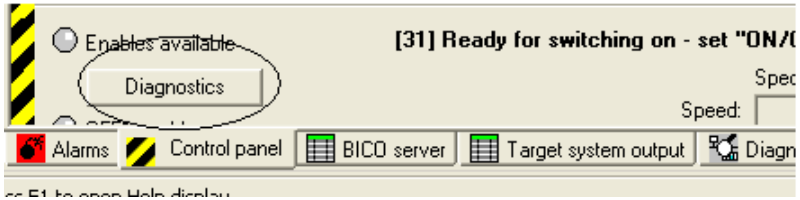
1. After stationery measurement select deactivate measurement.
2. Then select next measurement.

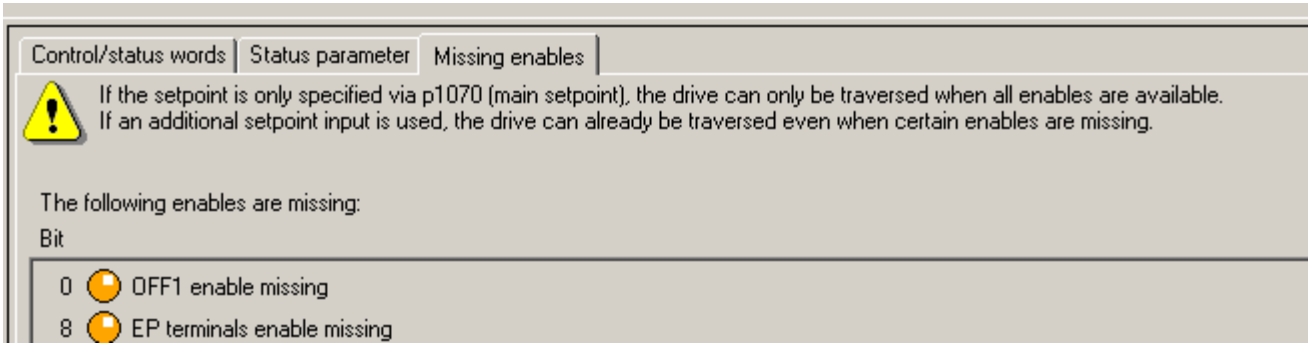
- Repeat steps taken for stationery except select turning measurement with encoder from the drop down menu,



Errors in rotating measurement

- If errors occur in rotating measurement test make sure that all steps have been followed correctly.
- Check drive diagnostics in control panel.



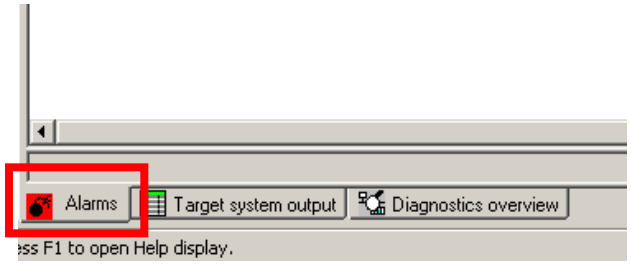


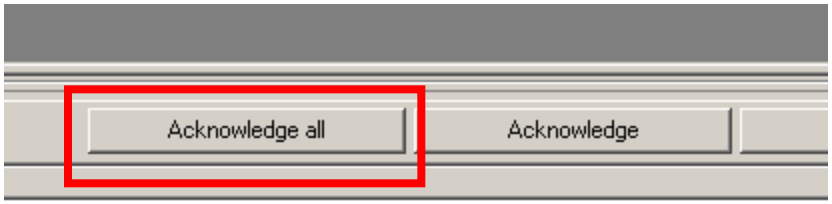
Sinamics

Errors in rotating measurement

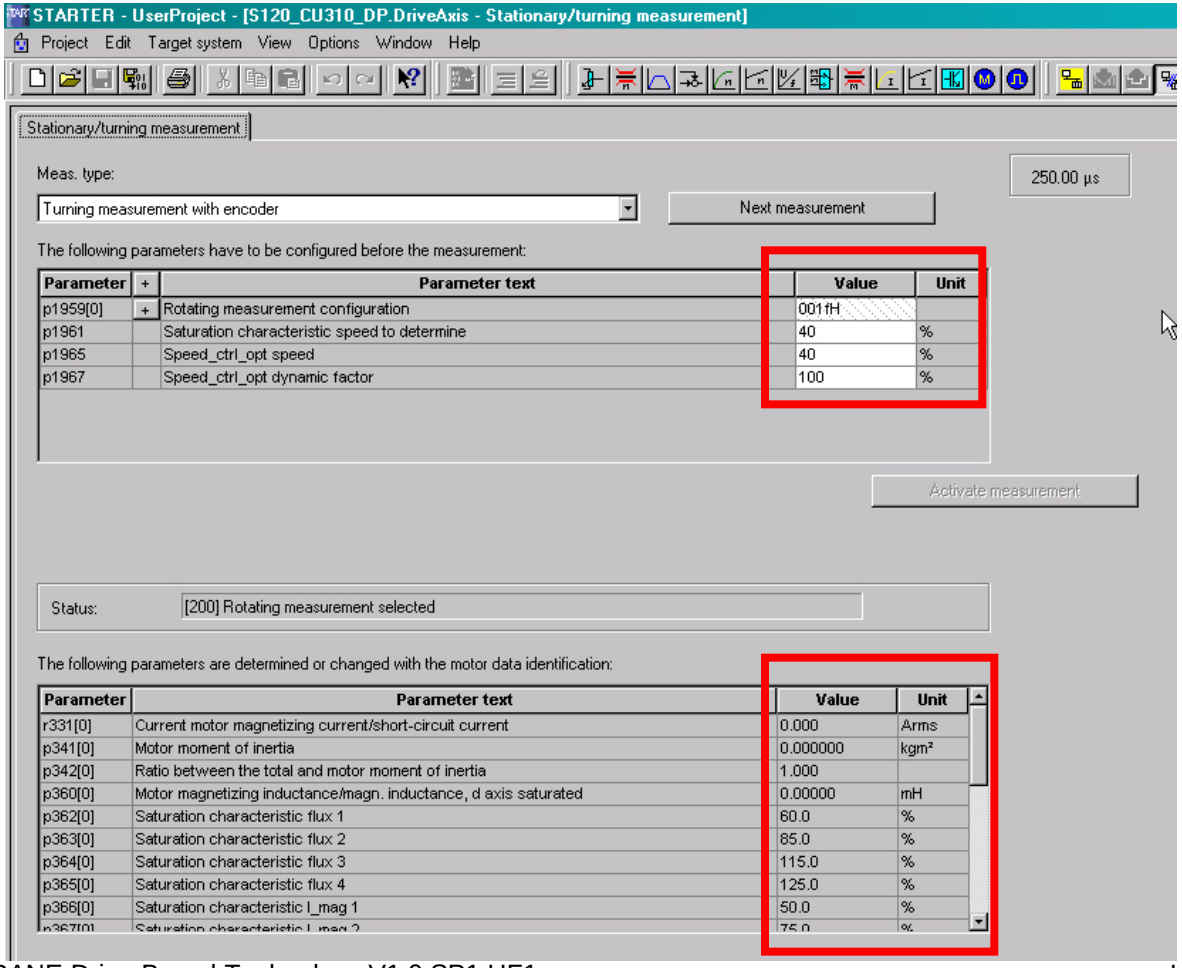
- Use alarm screen and click on error message for help to troubleshoot fault.

- To attempt rotating test again make sure to acknowledge errors in alarms screen.





Results of the rotating measurement



Step 4
Motor identification

Alternative to rotating measurement (refer to Chapter 6.3)

Simocrane

If the rotating measurement cannot be performed, it is possible to correct manually the missed rotating measurement settings:

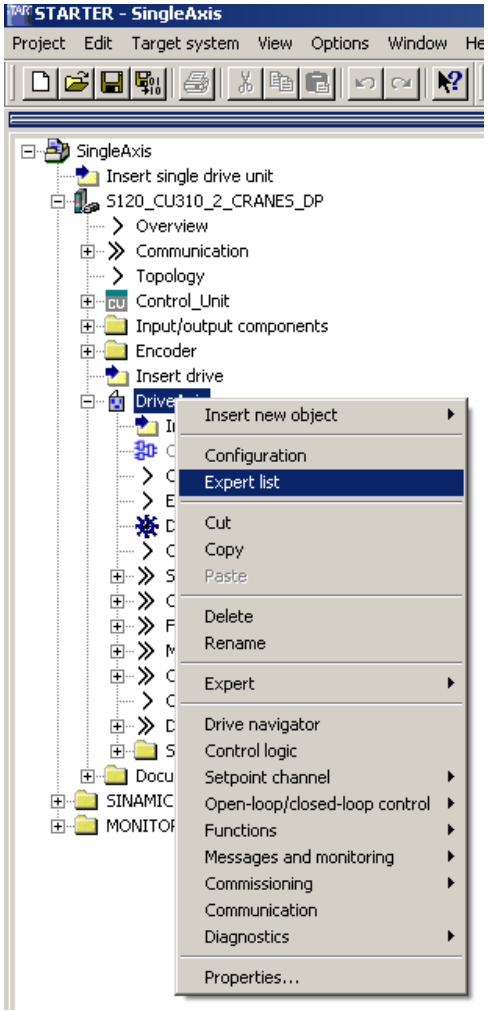
- To correct manually the magnetizing current and magnetizing inductance

- Speed control optimization by re-calculating the control parameters (p0340) or by optimizing manually the controller

Refer to the manual “SIMOCRANE Drive-Based Technology”, Chapter 6.3

Open the Expert list

Simocrane

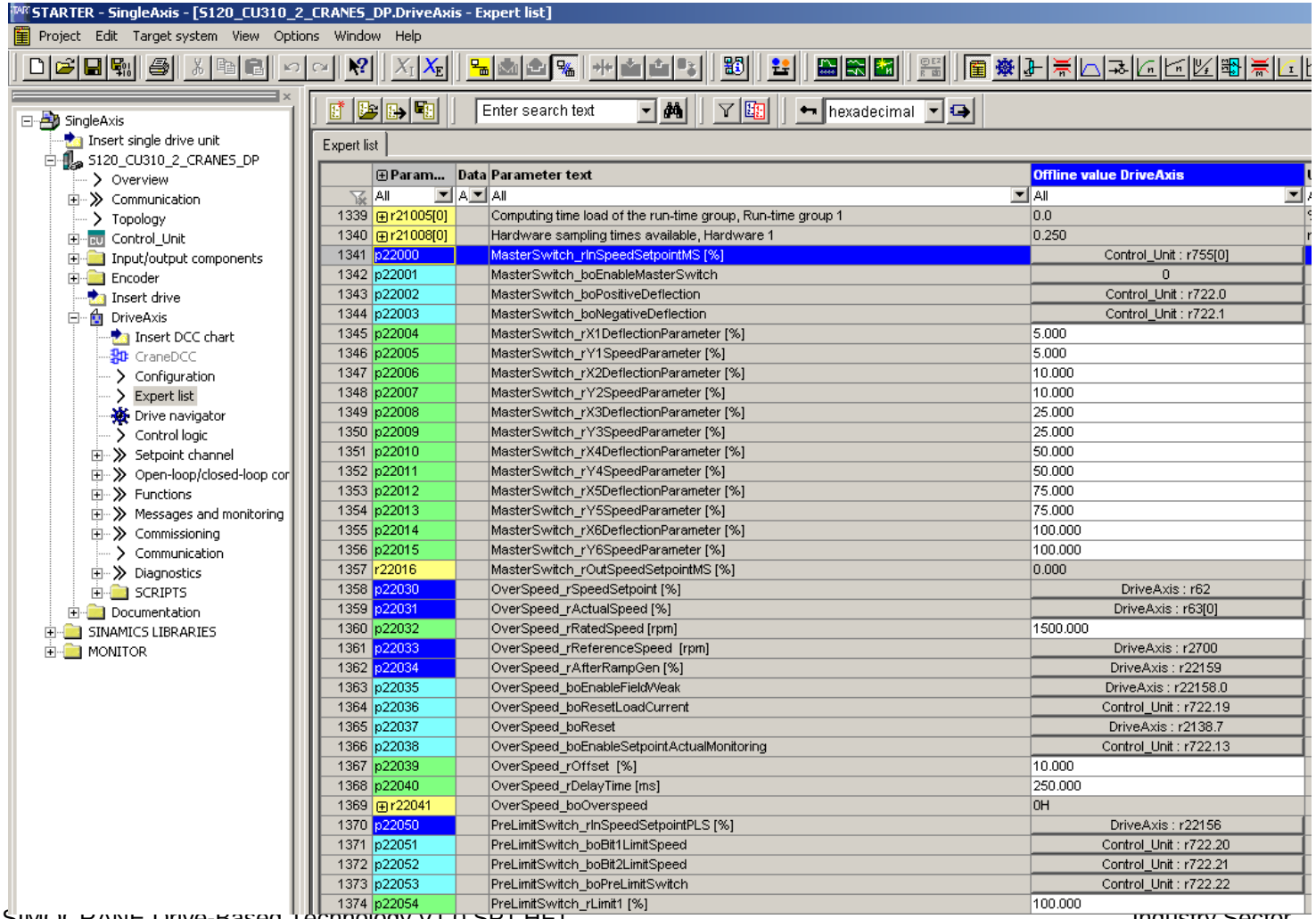


Select DriveAxis with the right mouse, a new window will be opened.

Select Expert and Expert list

Simocrane

DCC Parameters in the Expert list

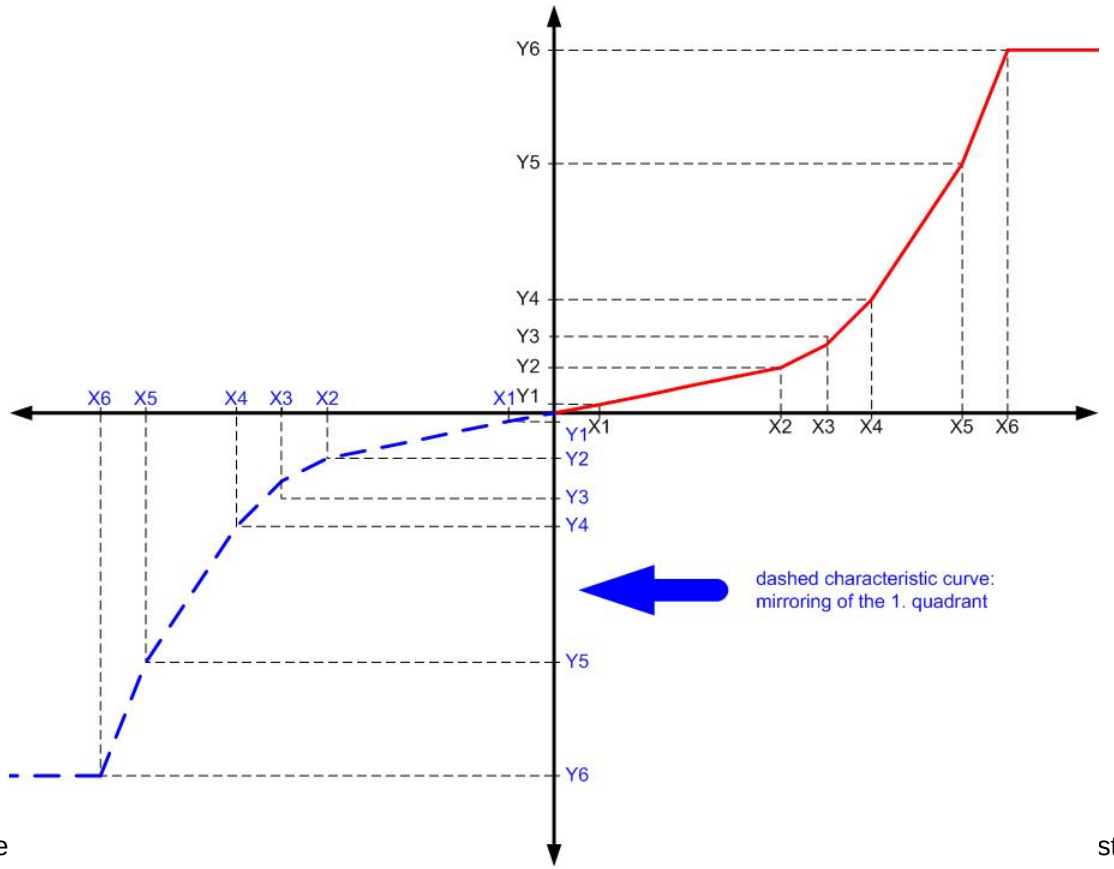


	Param...	Data	Parameter text	Offline value DriveAxis
	All	A	All	All
1339	r21005[0]		Computing time load of the run-time group, Run-time group 1	0.0
1340	r21008[0]		Hardware sampling times available, Hardware 1	0.250
1341	p22000		MasterSwitch_rInSpeedSetpointMS [%]	Control_Unit : r755[0]
1342	p22001		MasterSwitch_boEnableMasterSwitch	0
1343	p22002		MasterSwitch_boPositiveDeflection	Control_Unit : r722.0
1344	p22003		MasterSwitch_boNegativeDeflection	Control_Unit : r722.1
1345	p22004		MasterSwitch_rX1DeflectionParameter [%]	5.000
1346	p22005		MasterSwitch_rY1SpeedParameter [%]	5.000
1347	p22006		MasterSwitch_rX2DeflectionParameter [%]	10.000
1348	p22007		MasterSwitch_rY2SpeedParameter [%]	10.000
1349	p22008		MasterSwitch_rX3DeflectionParameter [%]	25.000
1350	p22009		MasterSwitch_rY3SpeedParameter [%]	25.000
1351	p22010		MasterSwitch_rX4DeflectionParameter [%]	50.000
1352	p22011		MasterSwitch_rY4SpeedParameter [%]	50.000
1353	p22012		MasterSwitch_rX5DeflectionParameter [%]	75.000
1354	p22013		MasterSwitch_rY5SpeedParameter [%]	75.000
1355	p22014		MasterSwitch_rX6DeflectionParameter [%]	100.000
1356	p22015		MasterSwitch_rY6SpeedParameter [%]	100.000
1357	r22016		MasterSwitch_rOutSpeedSetpointMS [%]	0.000
1358	p22030		OverSpeed_rSpeedSetpoint [%]	DriveAxis : r62
1359	p22031		OverSpeed_rActualSpeed [%]	DriveAxis : r63[0]
1360	p22032		OverSpeed_rRatedSpeed [rpm]	1500.000
1361	p22033		OverSpeed_rReferenceSpeed [rpm]	DriveAxis : r2700
1362	p22034		OverSpeed_rAfterRampGen [%]	DriveAxis : r22159
1363	p22035		OverSpeed_boEnableFieldWeak	DriveAxis : r22158.0
1364	p22036		OverSpeed_boResetLoadCurrent	Control_Unit : r722.19
1365	p22037		OverSpeed_boReset	DriveAxis : r2138.7
1366	p22038		OverSpeed_boEnableSetpointActualMonitoring	Control_Unit : r722.13
1367	p22039		OverSpeed_rOffset [%]	10.000
1368	p22040		OverSpeed_rDelayTime [ms]	250.000
1369	r22041		OverSpeed_boOverspeed	0H
1370	p22050		PreLimitSwitch_rInSpeedSetpointPLS [%]	DriveAxis : r22156
1371	p22051		PreLimitSwitch_boBit1LimitSpeed	Control_Unit : r722.20
1372	p22052		PreLimitSwitch_boBit2LimitSpeed	Control_Unit : r722.21
1373	p22053		PreLimitSwitch_boPreLimitSwitch	Control_Unit : r722.22
1374	p22054		PreLimitSwitch_rLimit1 [%]	100.000

Step 5
Parameterization
Crane DCC

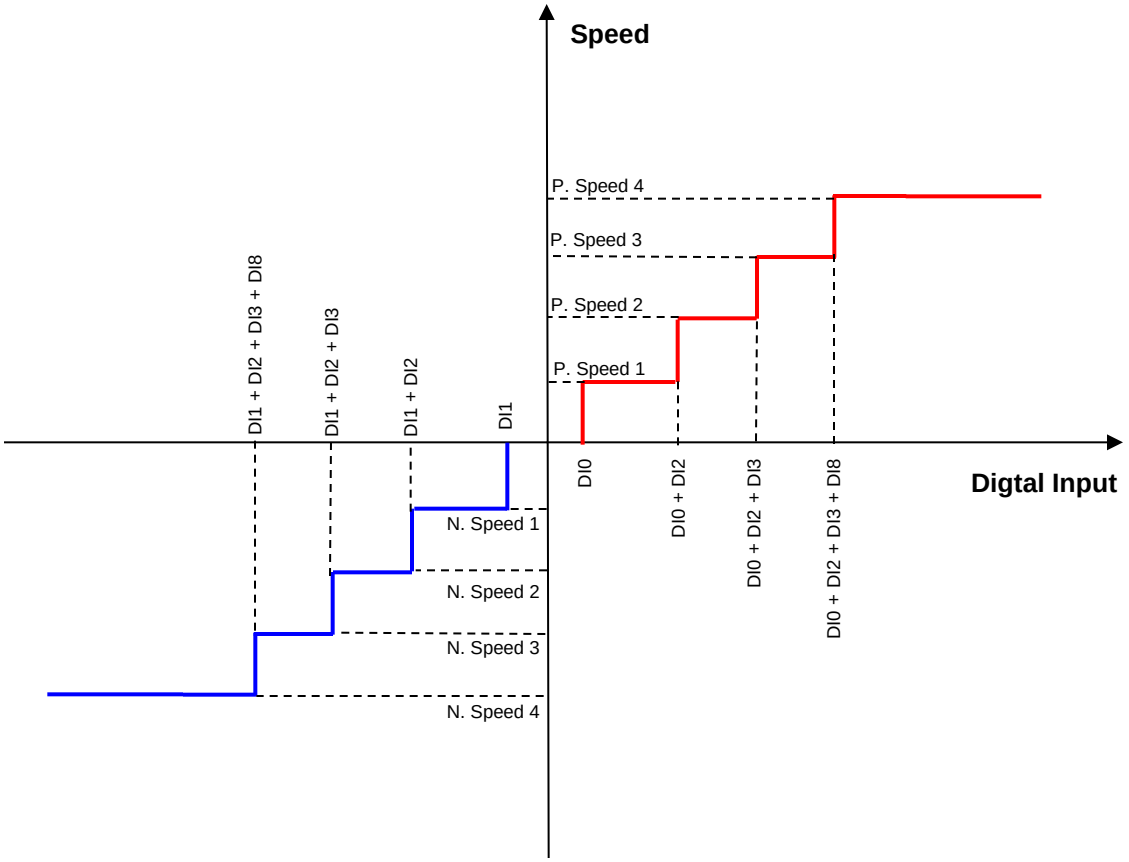
DCC_MasterSwitch (refer to Chapter 4.2)

In order that for low deflection angles lower speed setpoints are obtained than those that correspond linearly to the deflection angle, the master switch setpoint is modeled through a non-linear function. This allows the drive to be precisely positioned in the manual mode.



DCC_DigitalMasterSwitch (refer to Chapter 7.1.1)

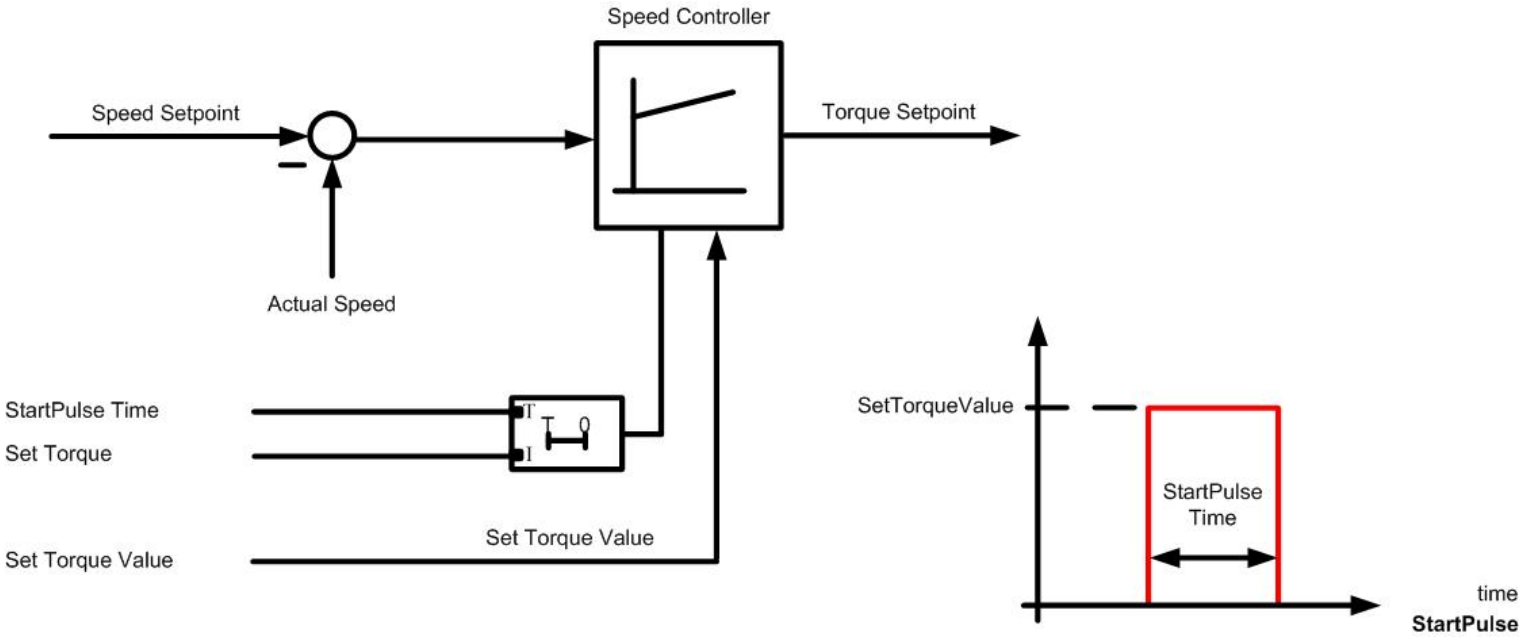
Simocrane



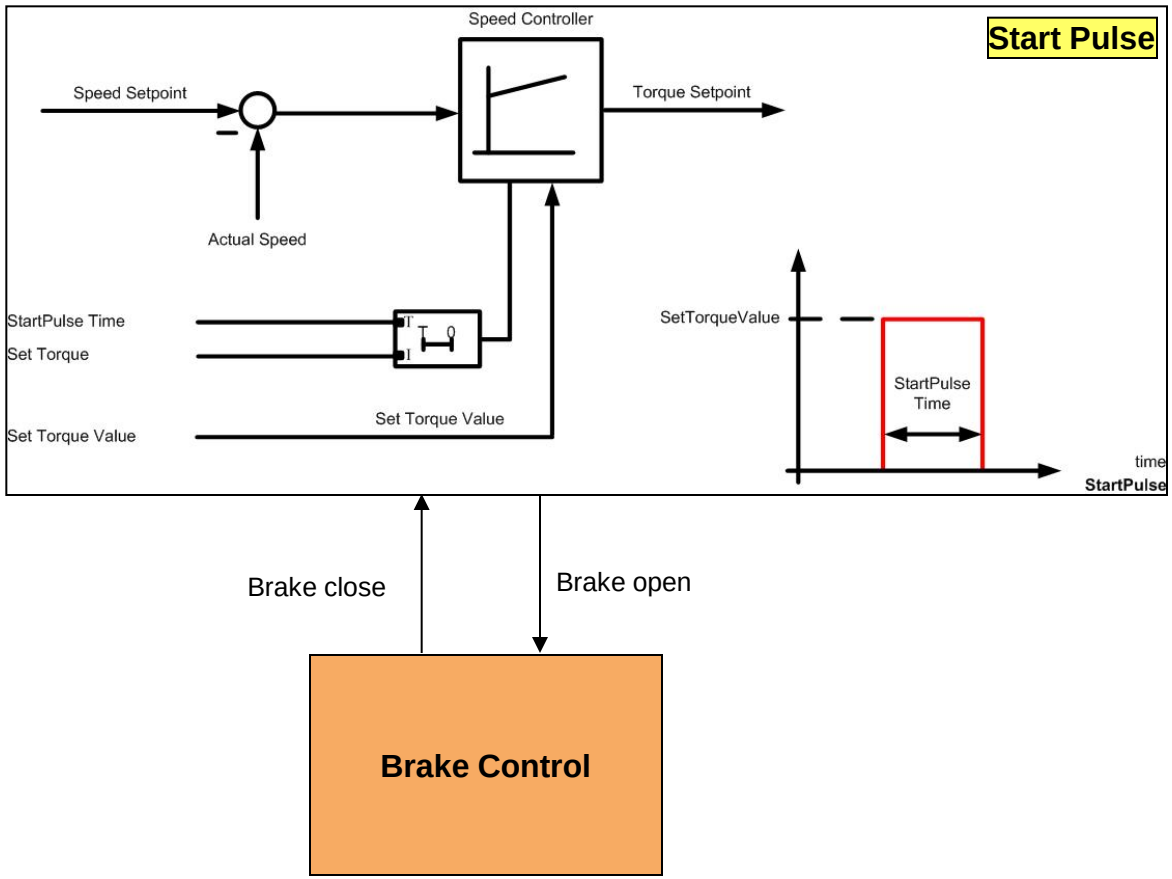
Simocrane

DCC_Startpulse (refer to Chapter 4.3)

For hoists, when starting (i.e. opening the hoisting gear brake) with freely suspended load, often the load undesirably sags. The reason for this is that the torque is not available when starting.
When starting with a suspended load, the torque must be quickly established.



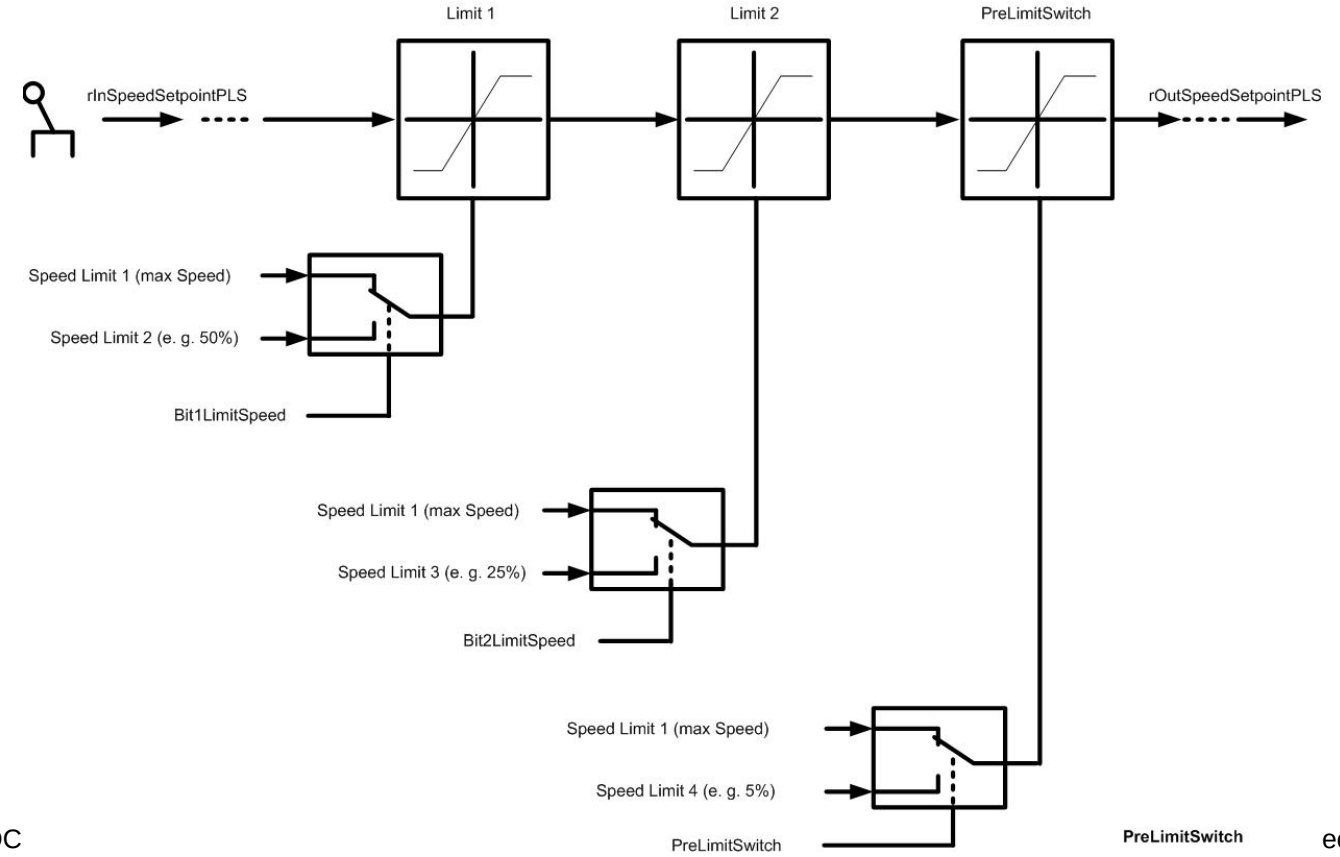
DCC_Startpulse in combination of Brake control



Simocrane

DCC_PreLimitSwitch (refer to Chapter 4.4)

This function prevents that the drive moves with full speed to the limit switch or to the safety buffer. A total of 4 different speed limits can be configured. Interconnect the maximum speed with speed limit 1. This limits speed to the maximum value.

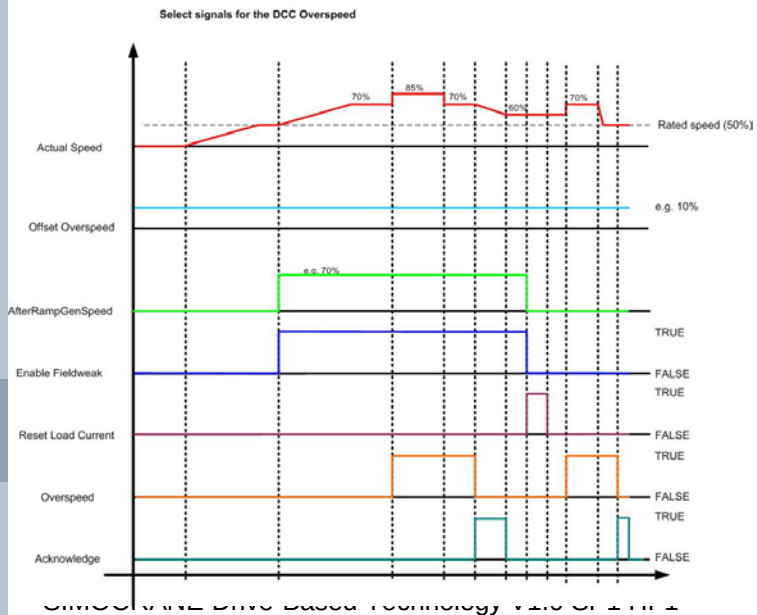


Simocrane

DCC_Overspeed (refer Chapter 4.5)

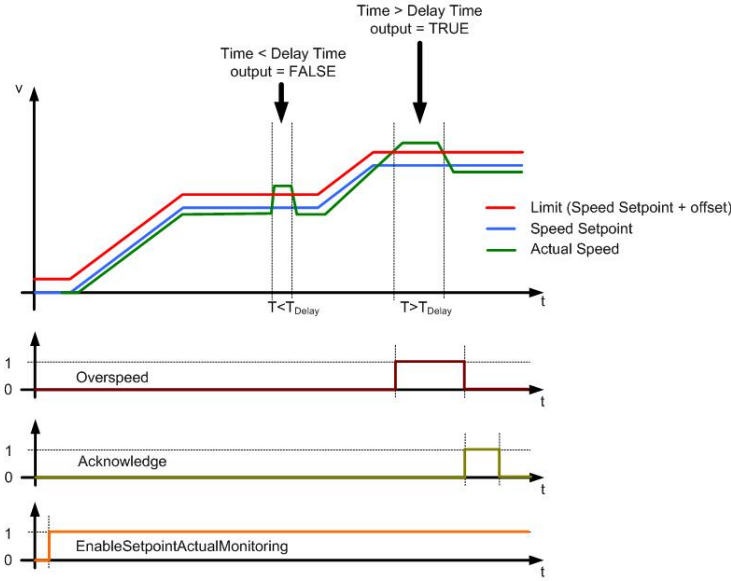
Function 1

to monitor the actual velocity for an overspeed condition. Compared value can be either in range of the rated speed or in field weakening area.



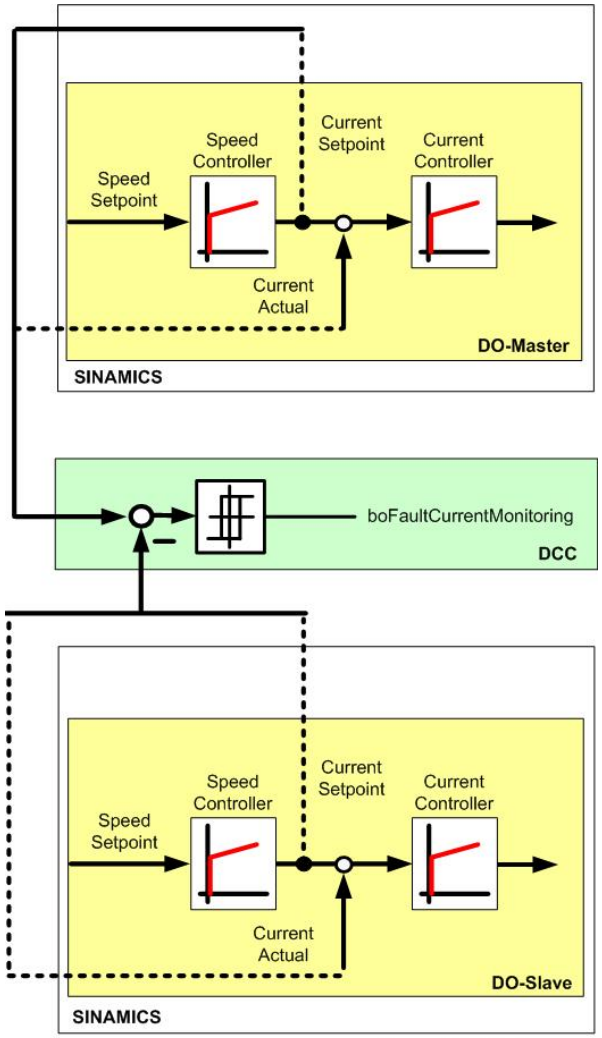
Function 2

to monitor continuously setpoint-actual value deviation



Simocrane

DCC_CurrentDistributionMon (refer to Chapter 4.6)



This function can be used for master-slave operation or synchronous operation. The block monitors that the total current of both drives is distributed evenly.

In synchronous operation, the current setpoint value is monitored for the two drives. In master-slave operation, the current actual values of two drives are monitored.

If the difference of the setpoint or actual currents of both drives exceeds the configured values for deviation and time, then output r22037 "boFaultCurrentMonitoring" is set.

DCC_LoadDependingFieldWeak (refer to Chapter 4.7 and 6.5)

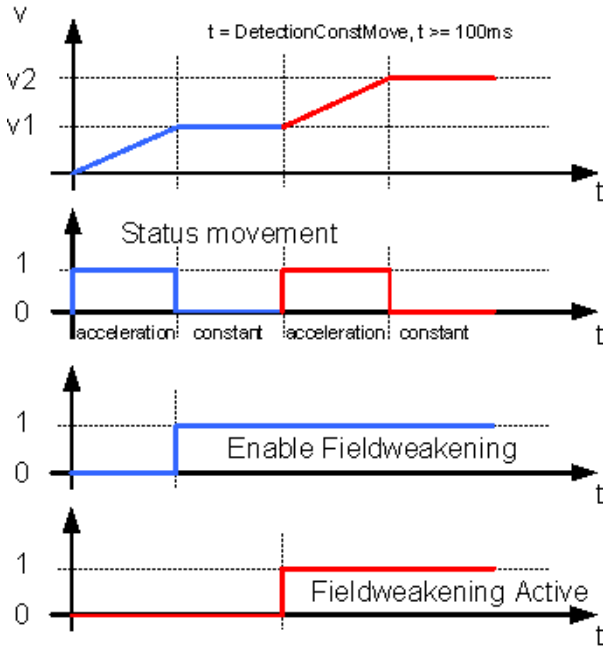
Simocrane

When selecting field weakening, e.g. using the master switch, a supplementary speed setpoint for field weakening, which is permissible for the actual load, is generated.

Theoretical basics and equations

The steady-state load torque is calculated as follows:

MM = MLoad + MFriction
MM: Motor torque
MLoad: Load torque
MFriction: Frictional torque



Commissioning instructions

1. To generate the measured variables (refer to chapter 6.5.2.1)
2. Compensating the frictional torque (refer to chapter 6.5.2.2)
3. Correcting the efficiency (refer to chapter 6.5.2.3)
4. Calculating the physical size of the load (refer to chapter 6.5.2.4)

After commissioning save the project

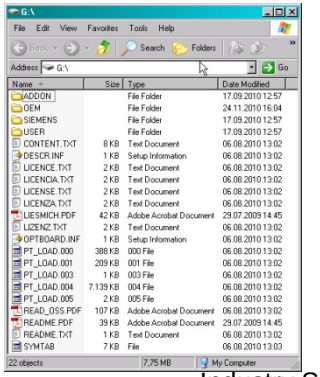
Sinamics

After the Commissioning is finished, following steps must be done:

- Copy RAM to ROM (all settings will be saved on CF card)

- If the parameter settings in the CU310 are changed online, then upload the project to PG and save the project in the STARTER.

- Do a copy of the complete CF flash card to the hard-disc as a backup.



SIMOCRANE Product Support

- SIMOCRANE Product-Support (news, FAQs, Manuals,..) in Internet

http://support.automation.siemens.com/WW/view/en/10807397/130000

- Crane Application note:

http://support.automation.siemens.com/WW/view/de/48342008/136000

- New: Support request via Internet (Product → Simocrane) :

  http://support.automation.siemens.com

- New: Hotline EUROPA

  – Telefon: +49 (0) 911 895 7 222

  – Fax: +49 (0) 911 895 7 223

  – Email: support.automation@siemens.com

- New: Hotline AMERICA

– Telefon: +1 423 262 5710

– Fax: +1 423 262 2231

– Email: support.america.automation@siemens.com

- New: Hotline ASIA / PACIFIC

– Telefon: +86 10 6475 7575

– Fax: +86 10 6474 7474

– Email: support.asia.automation@siemens.com

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